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U.S. Army
Environmental
Center

Revised Final
Phase I Environmental Investigation Report, Fort Benjamin Harrison, Marion County, Indiana
Volume I of II

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September 18, 1995

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EXECUTIVE SUMMARY

INTRODUCTION

This report was prepared by Harding Lawson Associates (HLA) for the U.S. Army Environmental Center (USAEC) to present the results of a Phase I **Environmental Investigation (EI)*** performed at Fort Benjamin Harrison (FBH) during late 1993 through early 1994. This investigation concerned several areas requiring environmental evaluation (AREEs) identified for investigation in the Enhanced **Preliminary Assessment** conducted by Roy F. Weston, Inc. (Weston), for the **U.S. Army Soldier Support Center (USASSC)** at FBH. The Phase I EI also involved other areas that were not listed in the Enhanced Preliminary Assessment but were requested for investigation by the **U.S. Environmental Protection Agency (EPA)** Region V. The following sections of this executive summary describe site background, provide an overview of the EI process at FBH, summarize the Phase I EI, and provide conclusions and recommendations from the Phase I investigation.

SITE BACKGROUND

FBH is an Army installation consisting of approximately 2501 acres in Lawrence Township, Marion County, Indiana. FBH is approximately 12 miles northeast of downtown Indianapolis, as shown in Figure ES.1. The land surface slopes downward from the nearly level uplands in the south toward the bottomland along Fall Creek in the north. **Surface water** flows primarily to the northwest in four major streams and three **intermittent streams**. Three reservoirs on the installation are stocked with fish and used as fishing and recreational areas. Approximately 40 percent of the area of FBH is covered by woodlands.

* Words shown in bold print are defined in the glossary at the end of this executive summary.

The surface geology consists of **glacial till**, which is mostly clayey, low **permeability** deposits intermixed with occasional sand and gravel units, and **unconsolidated alluvial deposits** along the rivers and streams. The surficial deposits are underlain by **limestone** and **dolomite bedrock** at 150 to 250 feet below ground surface (bgs). Shallow **groundwater** is encountered at approximately 5 to 20 feet bgs, while a deeper groundwater system is encountered at depth in thicker sand and gravel units of the glacial till and the dolomite and limestone bedrock. Groundwater in the area of FBH is withdrawn from the deeper **aquifer** as a water supply for several municipalities.

FBH was created by an act of the U.S. Congress on March 3, 1903. It was originally established as an infantry regiment post, and during World War I became a training camp for officers and engineers. Between World War I and World War II, FBH was used as a training center for military and civilian personnel. From 1941 to 1945, FBH was the site of an induction and reception center for military draftees, home to several Army schools, a prisoner of war camp, an Army disciplinary barracks, and a 1000-bed hospital. In 1948, FBH was relinquished to the U.S. Air Force for use as an Air Force base; however, the installation was found to be inadequate for this use and was returned to Army command in 1950. During the 1950s, FBH became the Army Finance Center and has been used for administration and training ever since. FBH was reorganized in 1980 and was designated as the U.S Army Soldier Support Center (USASSC).

In 1991, FBH was placed on the U.S. Department of Defense's Base Closure List. The 1991 Defense Closure and Realignment Commission recommended that FBH close by 1997. Property disposal and reuse activities associated with the closure of the installation were initiated in October 1991 and have continued to the present. One 144-acre parcel, the U.S. Army Reserve Component Enclave in the southeastern part of the installation at FBH, will be retained by the Army after transfer of the remainder of the installation.

FORT BENJAMIN HARRISON ENVIRONMENTAL INVESTIGATION

In March 1989, USAEC was assigned the responsibility for centrally managing the Base Realignment and Closure Program at FBH. As a result of this assignment, USAEC conducted an Enhanced Preliminary Assessment (Weston, 1992) for FBH in October 1991 as a precursor to a possible **remedial investigation/feasibility study (RI/FS)**. Thirty-six AREEs were identified and evaluated during the Enhanced Preliminary Assessment. Some of these areas, after additional review, were eliminated from further consideration, and 21 of the 36 AREEs identified in the Enhanced Preliminary Assessment were selected for investigation during a Phase I EI. These sites are summarized in Table ES.1, along with the reasons for investigation and the objectives of the Phase I EI. In addition, at the direction of the EPA, the Phase I EI also included investigation of 11 historic military sites and the "Patriotic Site" was added by the USAEC.

The EI at FBH is being conducted in two phases to address **releases** or suspected releases of **hazardous substances**. Results of the completed Phase I (release assessment) field work and analytical data for each EI site were used to (1) evaluate whether a release of hazardous substances has occurred and (2) provide recommendations for further action under Phase II, if necessary. Phase II (release characterization) field work and analytical data will be used to (1) better characterize the nature and extent of contamination at each EI site, where necessary, for which the Phase I data indicate a potential threat to human health and the environment (2) support the **baseline risk assessment/ecological risk assessment** for chemicals of concern identified at the site, and (3) support an **alternatives analysis** at sites where the risk assessment indicates that cleanup is warranted. A summary of the Phase I EI activities is provided below.

SUMMARY OF PHASE I ENVIRONMENTAL INVESTIGATION

The Phase I EI at FBH consisted of investigating each EI site, collecting **background samples** of soil and groundwater and basewide samples of surface-water and sediment, and comparing analytical investigative and background sampling results.

Twenty-eight sites and additional background sampling locations were investigated during the Phase I EI. The locations of these EI sites are shown in Figure ES.2. The field sampling program for the Phase I EI was conducted according to an approved **Technical Sampling Plan** (HLA, 1993) and included the following major activities:

- **Soil-gas** surveys
- **Polychlorinated biphenyl (PCB) screening** (surface soil)
- **Geophysical surveys**
- **Surface soil** sampling
- **Soil borings** and **subsurface soil** sampling
- **Monitoring well** installation and groundwater sampling
- Surface-water sampling
- **Sediment** sampling

These activities are summarized in Table ES.2, as well as the intended investigative objective, the **medium** sampled (e.g., soil), the number of samples collected, the chemical analyses performed, and a brief summary of the investigation results.

As part of the field program for the Phase I EI, surface soil, subsurface soil, and groundwater samples were collected to assess **background concentrations**. Background sampling locations were chosen that, based on available information, had not been influenced by EI site-related activities and were thought to be representative of either natural or **ambient** conditions. Twenty-one surface soil samples were collected to assess ambient concentrations of **target analytes** in surface soil. Forty-nine subsurface soil samples were collected from 15 borings to assess ambient concentrations in subsurface soil. Seven new and 10 previously existing monitoring wells were sampled to assess ambient concentrations in groundwater. These background samples were analyzed for the same **analytes** as the samples collected from the EI sites. Samples collected during the Phase I EI were analyzed using USAEC-approved methods that were based on EPA-approved methods (EPA, 1986), and analytical

data were **validated** using either EPA functional guidelines (EPA, 1988 and 1991) or Army validation procedures.

IDEM reviewed the background analytical results for surface soil, subsurface soil, and groundwater samples collected by the Army to identify the background screening concentrations used in this report. IDEM identified these concentrations (Lorraine Wright, Personal Comm., 1995) by selecting a subset of the background samples that IDEM believes to be representative of background conditions at FBH. (IDEM selected these samples by reviewing sampling locations and analytical results.) The analytical result for these samples were categorized by soil series (surface soil) or sample depth (subsurface soil), and tabulated. Groundwater samples were not categorized prior to tabulating. The maximum target analyte concentration for each category of sample medium was identified as the analyte concentration for background screening.

IDEM did not identify background concentrations for **organic compounds** and selected **landfill parameters**. Instead, IDEM directed the Army to consider concentrations greater than the detection limit of organic compounds, total organic carbon, ammonia, and nitrites/nitrates as exceeding background. Therefore, all Phase I EI detections of these analytes were evaluated for the EI.

Validated data were then used to conduct a data evaluation process. The purpose of the evaluation process is twofold. First, it serves as a screening mechanism to eliminate from further investigation those EI sites where analytical samples were collected but no constituents exceeded IDEM background concentrations. (Analytical samples were not collected at some Phase I EI sites.) The second purpose is to recommend appropriate Phase II activities at sites where one or more constituents exceed IDEM background concentrations. Recommended Phase II investigation activities include additional background sampling and evaluation, additional investigative sampling to evaluate the nature and extent of constituents at the site, baseline risk assessment/ecological risk assessment, and

implementation of **interim remedial measures**. Not all of the EI sites are expected to advance through the entire EI process and require remediation.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

General conclusions based on the results of the Phase I EI on a basewide scale are summarized below. Conclusions related to individual EI sites are summarized in Table ES.3.

The evaluation of analyte concentrations in background media (e.g., soil, sediment, groundwater, and surface water) revealed two areas that may need to be addressed during future phases of investigation:

- Background metals concentrations in soil and sediment at FBH do not appear to have been adequately characterized. Background analysis has not screened out metals in soil at several sites where the metals are likely to be natural and unrelated to activities at the EI site.
- Pesticides such as DDT, DDD, DDE, and chlordane were detected in many surface soil samples collected basewide, including background samples. This wide distribution of pesticides may be indicative of historical basewide pesticide application and may not be related to EI site-specific activities.

The number and concentration of constituents detected in environmental media (e.g., soil, sediment, surface water, and groundwater) related to known site-specific activities are small. With a few exceptions, as noted in Table ES.3, the number and concentrations of detections of organic compounds of concern at EI sites are low. The metals concentrations in soil at most of the EI sites are not significantly elevated above IDEM background values. However, soil collected at a few sites, notably the firing ranges (EI Sites SM21, SM22, and SM23) contain high concentrations of metals resulting from use of these sites as firing ranges.

The chemical makeup of groundwater changes throughout the year and for that reason, chemicals detected in groundwater samples may vary seasonally or with time. Therefore, an additional

basewide groundwater event combined with a basewide water-level survey would be beneficial to understanding groundwater chemistry, flow direction, and water-level fluctuations across FBH.

RECOMMENDATIONS

The recommendations for further action made on the basis of the Phase I EI are listed in Table ES.3. In addition to the EI site-specific recommendations, the following recommendations are made for basewide issues:

- Reevaluate FBH background metals and pesticide concentrations to identify representative background concentrations. Additional background sampling should be conducted for the reevaluation.
- Conduct a second basewide groundwater sampling and water-level measurement event of all existing wells to further characterize groundwater quality and flow.

The numbers of samples to be collected and the chemical analyses to be performed will be specified in the Phase II Sampling Plan.

GLOSSARY

Alluvial deposits - Geologic materials deposited by rivers or streams.

Alternative analysis - Process of systematically reviewing and selecting technologies for remediation (clean up) of a site.

Ambient - Present in or characteristic of the surrounding environment.

Analyte - A chemical element or compound that is being tested for in a chemical analysis.

Aquifer - A saturated soil or rock formation that contains enough permeability to yield groundwater on a continuing basis to a well or spring.

Background concentration - The concentration of a chemical that is naturally occurring, or that has resulted from releases outside the EI site or facility.

Background sample - A sample that is collected from what is believed to be an undisturbed area for assessing background concentrations.

Baseline risk assessment/ecological risk assessment - An assessment of human health and non-human species risk based on exposure to the chemical concentrations found in samples collected at a facility.

Bedrock - A general term for the consolidated rock that underlies soil or other unconsolidated geologic material.

Dolomite - A common rock-forming mineral containing calcium and magnesium often occurring in extensive beds.

Environmental investigation (EI) - General term referring to activities associated with the gathering of site-specific data to evaluate areas of environmental concern.

Feasibility study - A study wherein remedial alternatives for cleaning up site contamination are identified, screened, and compared.

Geophysical survey - The use of geophysical instruments such as well-logging tools to assess contrasts in subsurface soil properties without obtaining samples for chemical analysis.

Glacial till - Earth materials, usually high in fine grained clays or silts, that are transported and deposited by movement of a glacier.

Groundwater - Underground water present in the voids between soil particles.

Hazardous substance, - A substance, material, or constituent, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Indiana Department of Environmental Management (IDEM) - The agency of the State of Indiana that regulates hazardous waste management and environmental compliance under state or federal regulations.

Interim remedial measure - A remedial measure implemented to achieve a partial remedy or mitigate contamination at a facility in advance of a final remedy.

Intermittent stream - A stream that does not flow consistently throughout the year; many intermittent streams flow only after a rain or during the wetter part of the year.

Landfill parameters - Specific list of analytes evaluated during the Phase I EI. Analytes include common ions, organic carbon, nitrogen compounds, and total phenolics.

Limestone - A type of sedimentary rock formed in a marine environment and consisting predominantly of calcium carbonate.

Medium (media) - An environmental substance(s) such as air, groundwater, surface water, sediment, surface soil, or subsurface soil.

Monitoring well - A well that is drilled and completed with the purpose of obtaining samples of groundwater from a specific geologic interval for chemical analysis and environmental evaluation.

Organic compound - Any of the analytes, analyzed for in FBH samples, that contain the element carbon.

Owner/operator - The person, company, or other legal entity that owns and/or operates a facility.

Polychlorinated biphenyl (PCB) screening - Testing for polychlorinated biphenyls using a test kit that can be used to obtain semiquantitative results in the field.

Permeability - The property or capacity of a porous rock, sediment, or soil for transmitting a fluid; it is a measure of the relative ease of fluid flow under unequal pressure.

Preliminary assessment - An assessment usually conducted by EPA or an authorized state agency to identify and evaluate potential environmental concerns at a facility.

Release - Spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, disposing, or dumping into the environment.

Remedial investigation - A study that reports the types, amounts, and locations of contamination at a site.

Sediment - Solid material from weathering of rocks that is deposited by air, water, ice, or other natural agents that forms in loose, unconsolidated layers.

Soil boring - Small diameter shaft drilled in soil for the purpose of examining and collecting subsurface soil samples.

Soil gas - The gas present between soil particles or grains in unsaturated soil.

Subsurface soil - The soil deeper than approximately 1 foot below ground surface.

Surface soil - The soil present at the ground surface and to a depth of approximately 1 foot below ground surface.

Surface water - Water that is present at the surface of the earth, as in streams or lakes.

Target analyte - A chemical constituent that is specifically tested for in an environmental investigation.

Technical Sampling Plan - A plan developed to describe the field activities that will be conducted during an EI.

U.S. Environmental Protection Agency (EPA) - The agency of the federal government that enforces federal regulations related to environmental quality.

U.S. Army Soldier Support Center (USASSC) - The designation of Fort Benjamin Harrison since 1980, which identifies its responsibility as personnel service support including finance, religion, legal aid, music, public affairs, morale, welfare, and recreation.

Unconsolidated - Consisting of loose, uncompacted, or uncemented geologic materials.

Validate/validation - A procedure of making sure that all necessary steps were performed correctly to arrive at a result in a chemical analysis.

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Arthur D. Little, Inc. 1993. *Community environmental response facilitation act (CERFA) report, Fort Benjamin Harrison, Indiana.* October 29.

Roy F. Weston, Inc. 1992. *Delivery order 9, enhanced preliminary assessment, Fort Benjamin Harrison, Indiana.* Prepared for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland, February.

U.S. Environmental Protection Agency. 1986. *Test methods for evaluating solid waste physical/ chemical methods.* SW-846 Third Edition.

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Table ES.1: Environmental Investigation Sites Identified for Further Action in the Enhanced Preliminary Assessment

EI Site Number	EI Site Name	Enhanced PA AREE Number	Enhanced PA Description/Location	Enhanced PA Concern	Activity Recommended in Enhanced PA
1	Auto Craft Shop, Building 705	7	Maintenance Shops, Four Vehicle Maintenance Shops (Bldgs. 33, 127, 422, 705)	Solvents, waste oil, and other petroleum products, battery storage	Remove all waste oils and other petroleum products. Clean all exposed surfaces, including concrete floors, that show any staining or other signs of spills. Install four to six soil borings (sample 0 to 6 inches and 1 to 2 feet) around fill valve and other areas near waste oil tank at auto craft shop.
3	Former Post Exchange (PX) Gasoline Station, Building 619	8	Former Maintenance Shops (Bldgs. 13, 36, 38, 109, 116, 424, 425, 426, 619)	Waste oil and other petroleum products, solvents, battery storage	Clean all surfaces including concrete floors if there is staining. Install one or two borings (sample 0 to 6 inches and 2 to 3 feet) adjacent to Bldgs. 619, 13, 38, and former location of Bldg. 109.
4	Directorate of Installation Support (DIS) Engineering/ Maintenance, Building 26	12	DIS Engineering/Maintenance Building (Bldg. 26, Bldg. 108 [former location])	Paints, paint thinner, solvents, PCBs, ash	Clean all surfaces including concrete floors if there is staining. Collect destructive samples of the concrete floor in the northwest corner of Bldg. 26. Install one or two soil borings outside each building (sample 0 to 6 inches and 2 to 3 feet).
5	Electrical Shop, Building 4	17	Maintenance Shop, Electrical Shop (Bldg. 4); and PCB-containing Waste Storage Areas (Adjacent to Bldgs. 4, 46, and 110, Bldgs. 124, 125)	PCBs	Collect two to four surface soil samples (sample from 0 to 6 inches at each area).
6	Former Coal Storage Yard, Building 2	30	Former Coal Storage Yard (NE of Bldg. 2)	Runoff from coal (similar to acid mine drainage)	Install two to four confirmatory soil borings (sample 0 to 6 inches and 2 to 3 feet) in locations not previously sampled. Collect two to four sediment samples in drainage pathways.
SM18	Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27	18	Pesticide Mixing and Storage Areas, DIS Former Storage (Bldg. 27)	Pesticides	Install two soil borings in downslope direction (sample from 0 to 6 inches and 2 to 3 feet). Wipe and/or chip samples of building surfaces.
SM19	Pesticide Mixing and Storage Areas, Building 514	18	Pesticide Mixing and Storage Areas, Former Storage (Bldg. 514)	Pesticides	Collect two surface soil samples (sample from 0 to 6 inches). Wipe and/or chip samples of building surfaces.

Table ES.1 (continued)

EI Site Number	EI Site Name	Enhanced PA AREE Number	Enhanced PA Description/Location	Enhanced PA Concern	Activity Recommended in Enhanced PA
SM20	Pesticide Mixing and Storage Areas, DIS Entomology, Buildings 604 and 605	18	Pesticide Mixing and Storage Areas, DIS Storage and Mixing (Bldg. 605)	Pesticides	Install two to four soil borings (sample 0 to 6 inches and 2 to 3 feet). Collect two to four sediment samples in drainageway and in Hawthorne Lake; include background sample (sample 0 to 6 inches and 1 to 2 feet where possible). Wipe and/or chip samples of building surfaces.
SM21	Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, Building 674	18	Pesticide Mixing and Storage Areas, Golf course (Bldg. 674)	Pesticides	Collect two surface samples (sample 0 to 6 inches). Wipe and/or chip samples of building surfaces.
SM22	Firing Range, Foreman Rifle Range, Near Buildings 811 and 812	14	Training Areas/Ranges, Foreman Rifle Range (Bldg. 811, 812)	Metals	Conduct sediment and surface-water sampling in Schoon Creek Tributary to Lawrence Creek and in Lawrence Creek downstream and upstream of Foreman and State Police ranges.
SM23	Firing Range, State Police Pistol Range, Near Building 815	14	Training Areas/Ranges, State Police Pistol Range (Bldg. 815)	Metals	Conduct sediment and surface-water sampling in Schoon Creek Tributary to Lawrence Creek and in Lawrence Creek downstream and upstream of Foreman and State Police ranges.
SM24	Firing Range, Skeet/Rifle Range, Near Buildings 819 through 822	14	Training Areas/Ranges, Skeet/Rifle Range (Bldg. 819 to 822)	Metals	Install two to four soil borings at each outdoor firing range area (sample 0 to 6 inches and 2 to 3 feet). Install and sample monitoring wells based on results of soil borings.
SM26	Former Sewage Treatment Plant (West of Building 674)	20	Former Sewage Treatment Plants, Historic maps/south of Shafter Road (west of Bldg. 674)	Residual wastes (metals, petroleum products) not fully treated by STP; pesticides; petroleum products from fire training	Use geophysical survey, if necessary, to locate boundaries of former treatment beds off Shafter Road. Install two to four soil borings (sample 0 to 6 inches and 2 to 3 feet).
SM27	Former Sewage Treatment Plant (North of Building 509)	20	Former Sewage Treatment Plants, Historic files/east area of installation	Residual wastes (metals, petroleum products) not fully treated by STP; pesticides; petroleum products from fire training	Conduct further site reconnaissance to locate former east sewage plant. If location is found, use geophysical survey (if necessary) to locate boundaries and install two to four soil borings (sample at 0 to 6 inches and 2 to 3 feet).

Table ES.1 (continued)

EI Site Number	EI Site Name	Enhanced PA AREE Number	Enhanced PA Description/Location	Enhanced PA Concern	Activity Recommended in Enhanced PA
SM28	Wash Racks, Grease Racks, Oil/Water Separators	9	Wash Racks, Grease Racks, and Oil/Water Separators (Bldgs. 4, 36, 116, 127, 422 to 426, 500, 515, 705)	Oil and other petroleum products, other engine fluids, solvents	Inspect all oil/water separators to ensure proper operation without any leaks. Conduct tests/inspections to verify/determine outlet locations. Advance soil borings at and/or downslope of all oil/water separators, wash racks, and grease racks (sample 0 to 6 inches and 2 to 3 feet). One to two sediment samples if oil/water separators drain/drained to ditch/storm sewer.

AREE Area Requiring Environmental Evaluation
Bldg Building
EI Environmental Investigation
NE Northeast
PA Preliminary assessment
PCB Polychlorinated biphenyl
STP Sewage treatment plant

Table ES.2: Summary of Phase I Environmental Investigation

EI Site Number	EI Site Name	Phase I EI Objective	Investigation Activities Performed: Field Activity/ Medium Sampled	Number of Samples/Locations	Chemical Analysis	Results
1	Auto Craft Shop, Building 705	Assess release(s) to soil and groundwater	Soil-gas sampling	3	VOCs	---
			Subsurface soil sampling	15 from 5 borings	VOCs, TPH, Total metals	---
			Groundwater sampling	4 from 4 wells	VOCs, TPH	---
2	Roads and Grounds Vehicle Maintenance Shop, Building 422	Moved from EI program to the RFI program (See SWMU #FBH6)	---	---	---	---
3	Former Post Exchange (PX) Gasoline Station, Building 619	Assess release(s) to soil and groundwater	Soil-gas sampling	14	VOCs	---
			Subsurface soil sampling	15 from 5 borings	VOCs, TPH, Total metals	---
			Groundwater sampling	4 from 4 wells	VOCs, TPH	---
4	DIS Engineering/Maintenance, Building 26	Assess release(s) to soil and groundwater	Soil-gas sampling	19	VOCs	---
			Subsurface soil sampling	28 3	PCBs (field screening) Pesticides/PCBs	---
			Subsurface soil sampling	15 from 5 borings	VOCs, SVOCs, TPH, Total metals	---
			Groundwater sampling	4 from 4 wells	VOCs, SVOCs, TPH, Total metals, Dissolved metals	---
5	Electrical Shop, Building 4	Assess release(s) to soil	Surface soil sampling	21 5 2	PCBs (field screening) TPH Pesticides/PCBs	---
			Subsurface soil sampling	15 from 5 borings	Pesticides/PCBs, TPH	---

Table ES.2 (continued)

EI Site Number	EI Site Name	Phase I EI Objective	Investigation Activities Performed: Field Activity/ Medium Sampled	Investigation Activities Performed: Number of Samples/Locations	Investigation Activities Performed: Chemical Analysis	Results
6	Former Coal Storage Yard, Building 2	Assess release(s) to soil	Surface soil sampling	10	Total metals	---
			Subsurface soil sampling	10 from 10 borings	Total metals	---
SM18	Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27	Assess release(s) to surface water and sediment in basement of building	Surface-water sampling	2	Total metals, Dissolved metals, Pesticides/PCBs, Herbicides	---
			Sediment sampling	3	Total metals, Pesticides/PCBs, Herbicides	---
SM19	Pesticide Mixing and Storage Areas, Building 514	Assess release(s) to soil	Surface soil sampling	12	Pesticides/PCBs, Herbicides	---
SM20	Pesticide Mixing and Storage Areas, DIS Entomology, Buildings 604 and 605	Assess release(s) to soil, surface water, and sediment	Surface soil sampling	12	Pesticides/PCBs, Herbicides	---
			Subsurface soil sampling	4 from 4 borings	Pesticides/PCBs, Herbicides	---
			Surface-water sampling	2	Pesticides/PCBs, Herbicides	---
			Sediment sampling	2	Pesticides/PCBs, Herbicides	---
SM21	Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, West of Building 674	Assess release(s) to soil and sediment	Surface soil sampling	12	Pesticides/PCBs, Herbicides	---
			Sediment sampling	2	Pesticides/PCBs, Herbicides	---
SM22	Firing Range, Foreman Rifle Range, near Buildings 811 and 812	Assess release(s) to soil, surface water, and sediment	Surface soil sampling	11 11	Total metals Metal mass (physical field screening)	---
			Subsurface soil sampling	5 from 5 borings	Total metals, Metal mass (physical field screening)	---

Table ES.2 (continued)

EI Site Number	EI Site Name	Phase I EI Objective	Investigation Activities Performed: Field Activity/ Medium Sampled	Number of Samples/Locations	Chemical Analysis	Results
			Surface-water sampling	2	Total metals, Dissolved metals	---
			Sediment sampling	2	Total metals	---
SM23	Firing Range, State Police Pistol Range, near Building 815	Assess release(s) to soil, surface water, and sediment	Surface soil sampling	10 10	Total metals Metal mass (physical field screening)	---
			Subsurface soil sampling	5 from 5 borings	Total metals, Metal mass (physical field screening)	---
			Surface-water sampling	2	Total metals, Dissolved metals	---
			Sediment sampling	2	Total metals	---
SM24	Firing Range, Skeet/Rifle Range, near Buildings 819 through 822	Assess release(s) to soil	Surface soil sampling	17 17	Total metals Metal mass (physical field screening)	---
			Subsurface soil sampling	6 from 6 borings	Total metals, Metal mass (physical field screening)	---
SM25a	Historic Military Site	No site investigation	---	---	---	---
SM25b	Historic Military Site	Assess release(s) to soil	Geophysical survey	Limited	---	---
			Surface soil sampling	6	VOCs, SVOCs, Total metals, Pesticides/PCBs, Herbicides, Landfill parameters	---
			Subsurface soil sampling	0 samples from 1 boring	---	No evidence of subsurface debris
SM25c	Historic Military Site	Assess release(s) to soil	Geophysical survey	---	---	---

Table ES.2 (continued)

EI Site Number	EI Site Name	Phase I EI Objective	Investigation Activities Performed: Field Activity/ Medium Sampled	Investigation Activities Performed: Number of Samples/Locations	Investigation Activities Performed: Chemical Analysis	Results
			Soil-gas sampling	2	VOCs	---
			Subsurface soil sampling	11 from 5 borings	VOCs, SVOCs, Total Metals, Pesticides/PCBs, Herbicides, Landfill parameters	---
SM25d	Historic Military Site	No site investigation	---	---	---	---
SM25e	Historic Military Site	No site investigation	---	---	---	---
SM25f	Historic Military Site	Assess release(s) to soil	Geophysical survey	---	---	---
			Soil-gas sampling	4	VOCs	---
			Subsurface soil sampling	6 from 3 borings	VOCs, SVOCs, Total metals, Pesticides/PCBs, Herbicides, Landfill parameters	---
SM25g	Historic Military Site	No site investigation	---	---	---	---
SM25h	Historic Military Site	Assess release(s) to soil	Surface soil sampling	6	VOCs, SVOCs, Total metals, Pesticides/PCBs, Herbicides, Landfill parameters	---
SM25i	Historic Military Site	Assess release(s) to soil	Geophysical survey	---	---	---
			Surface soil sampling	6	VOCs, SVOCs, Total metals, Pesticides/PCBs, Herbicides, Landfill parameters	---
			Subsurface soil sampling	0 samples from 1 boring	---	No evidence of subsurface debris
SM25j	Historic Military Site	Assess release(s) to soil	Geophysical survey	---	---	---

Table ES.2 (continued)

EI Site Number	EI Site Name	Phase I EI Objective	Investigation Activities Performed: Field Activity/ Medium Sampled	Investigation Activities Performed: Number of Samples/Locations	Investigation Activities Performed: Chemical Analysis	Results
			Surface soil sampling	6	VOCs, SVOCs, Total metals, Pesticides/PCBs, Herbicides, Landfill parameters	---
			Subsurface soil sampling	0 samples from 1 boring	---	No evidence of subsurface debris
SM25k	Historic Military Site	Assess release(s) to soil	Surface soil sampling	6	VOCs, SVOCs, Total metals, Pesticides/PCBs, Herbicides, Landfill parameters	---
SM25l	Historic Military Site	No site investigation	---	---	---	---
SM26	Former Sewage Treatment Plant (West of Building 674)		Geophysical survey	---	---	---
SM27	Former Sewage Treatment Plant (North of Building 509)		Geophysical survey	---	---	---
SM28	Wash Racks, Grease Racks, Oil/Water Separators	No site investigation	---	---	---	---
SM29	Patriotic Site	Assess release(s) to soil	Subsurface soil sampling	2	VOCs, SVOCs	---
---	Background Sampling	Assess background concentrations in soil, groundwater	Surface soil sampling	21	SVOCs, Total metals, Pesticides/PCBs, Herbicides, Ammonia and nitrate, and Landfill parameters	Background soil and groundwater samples were used to establish background concentrations for the installation.
			Subsurface soil sampling	49	VOCs, SVOCs Total metals, pesticides/PCBs Herbicides, Landfill parameters	---

Table ES.2 (continued)

EI Site Number	EI Site Name	Phase I EI Objective	Investigation Activities Performed: Field Activity/ Medium Sampled	Investigation Activities Performed: Number of Samples/Locations	Investigation Activities Performed: Chemical Analysis	Results
			Groundwater sampling	17	VOCs, SVOCs, Total and dissolved metals, Pesticides/PCBs, Herbicides, and Landfill parameters	---
---	Basewide Sampling	Assess release(s) to surface water, sediment	Surface water sampling	15	VOCs, SVOCs, Total and dissolved metals Pesticides/PCBs, Herbicides, and Landfill parameters	These samples were used to assess potential source areas to surface water and sediment.
			Sediment sampling	19	VOCs, SVOCs Total metals, Pesticides/PCBs, Herbicides, Ammonia and nitrate	---

DIS Directorate of Installation Support
EI Environmental Investigation
PCBs Polychlorinated biphenyls
RFI Resource Conservation and Recovery Act Facility Investigation
TPH Total petroleum hydrocarbons
VOCs Volatile organic compounds
SVOCs Semivolatile organic compounds

Table ES.3: Summary of Phase I Environmental Investigation Conclusions and Recommendations

Site Identification	Conclusions	Recommendations for Phase II EI
EI Site 1: Auto Craft Shop, Building 705	Metals and organic compounds were detected at low concentrations in subsurface soil.	Collect groundwater samples to confirm groundwater quality, and perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site 3: Former Post Exchange (PX) Gasoline Station, Building 610	Organic compounds including possible gasoline or diesel constituents, and low concentrations of metals including lead were detected in subsurface soil samples. One organic compound detected in one groundwater sample.	Collect groundwater samples to confirm groundwater quality, and perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site 4: Directorate of Installation Support (DIS) Engineering/Maintenance, Building 26	Organic compounds including low concentrations of pesticides were detected in surface soil samples; chlorinated solvents and metals were detected in subsurface soil samples. Metals and organic compounds were detected in groundwater samples; however, organic compounds detected in groundwater samples collected at this site were likely not related to site-specific activities.	Collect groundwater samples to assess groundwater quality. Collect surface and subsurface soil samples to assess extent of pesticides in soil. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site 5: Electrical Shop, Building 4	Organic compounds including TPH, and low concentrations of pesticides and PCBs were detected in surface and subsurface soil samples.	Collect groundwater samples to confirm groundwater quality. Collect surface and subsurface soil to assess extent of organic compounds including TPH.
EI Site 6: Former Coal Storage Yard, Building 2	Low concentrations of metals were detected in surface and subsurface soil samples.	Collect additional surface and subsurface soil samples and analyze for organic compounds associated with coal. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site SM18: Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27	Metals, pesticides, and herbicides detected in sediment and standing water sampled from the basement of Building 27. Lawn adjacent to Building 27 may be affected from past practice of pumping water from basement onto the adjacent yard.	Collect groundwater samples to assess groundwater quality. Collect surface and subsurface soil samples to assess extent of metals and organic compounds in yard. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site. Clean and then demolish Building 27.
EI Site SM19: Pesticide Mixing and Storage Areas, Building 514	Pesticides and an herbicide were detected in surface soil samples collected at this site.	Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site SM20: Pesticide Mixing and Storage Areas, DIS Entomology, Building 605	Pesticides and herbicides were detected at low concentrations in soil, surface-water, and sediment samples collected at this site.	Collect groundwater samples to assess groundwater quality. Collect surface and subsurface soil samples to assess extent of organic compounds. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.

Table ES.3 (continued)

Site Identification	Conclusions	Recommendations for Phase II EI
EI Site SM21: Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, Building 674	Pesticides and herbicides were detected at low concentrations in surface soil and sediment samples collected at this site.	Collect groundwater samples to assess groundwater quality. Collect surface and subsurface soil samples to assess extent of organic compounds. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site SM22: Firing Range, Foreman Rifle Range, Near Buildings 811 and 812	Metals, including lead and copper, were detected in surface and subsurface soil, surface-water, and sediment samples collected at this site. Several metals identified are consistent with the use of this site as a firing range.	Conduct field screening for lead to delineate the extent of elevated lead concentrations in soil. Collect groundwater samples to assess groundwater quality. Perform a risk assessment for metals to evaluate risk associated with chemicals of concern identified at this site. Conduct an accelerated feasibility study, and select a treatment process for removal of lead and other metals from soil in the source area at this site.
EI Site SM23: Firing Range, State Police Pistol Range, Near Building 815	Metals, including lead and copper, were detected in surface and subsurface soil, surface-water, and sediment samples collected at this site. Several metals identified are consistent with the use of this site as a firing range.	Conduct field screening for lead to delineate the extent of elevated lead concentrations in soil. Collect groundwater samples to assess groundwater quality. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site. Conduct an accelerated feasibility study, and select a treatment process for removal of lead and other metals from soil in the source area at this site.
EI Site SM24: Firing Range, Skeet/Rifle Range, Near Buildings 819 through 822	Metals, including lead and copper, were detected in surface and subsurface soil samples collected at this site. Several metals identified are consistent with the use of this site as a firing range	Conduct field screening for lead to delineate the extent of elevated lead concentrations in soil. Collect groundwater samples to assess groundwater quality. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site. Conduct an accelerated feasibility study, and select a treatment process for removal of lead and other metals in the source area at this site.
EI Site SM25a: Historic Military Site - World War I-era entrenchment used for training activities	There is no indication that hazardous substances or hazardous materials were disposed of as waste by the Army at this site.	No further action.
EI Site SM25b: Historic Military Site - World War I-era dump	Indications that this site was used as a dump were not observed during site reconnaissance. However, organic compounds and metals were detected at low concentrations in surface soil samples collected at this site.	Perform a risk assessment to evaluate risks associate with chemicals of concern identified at this site.

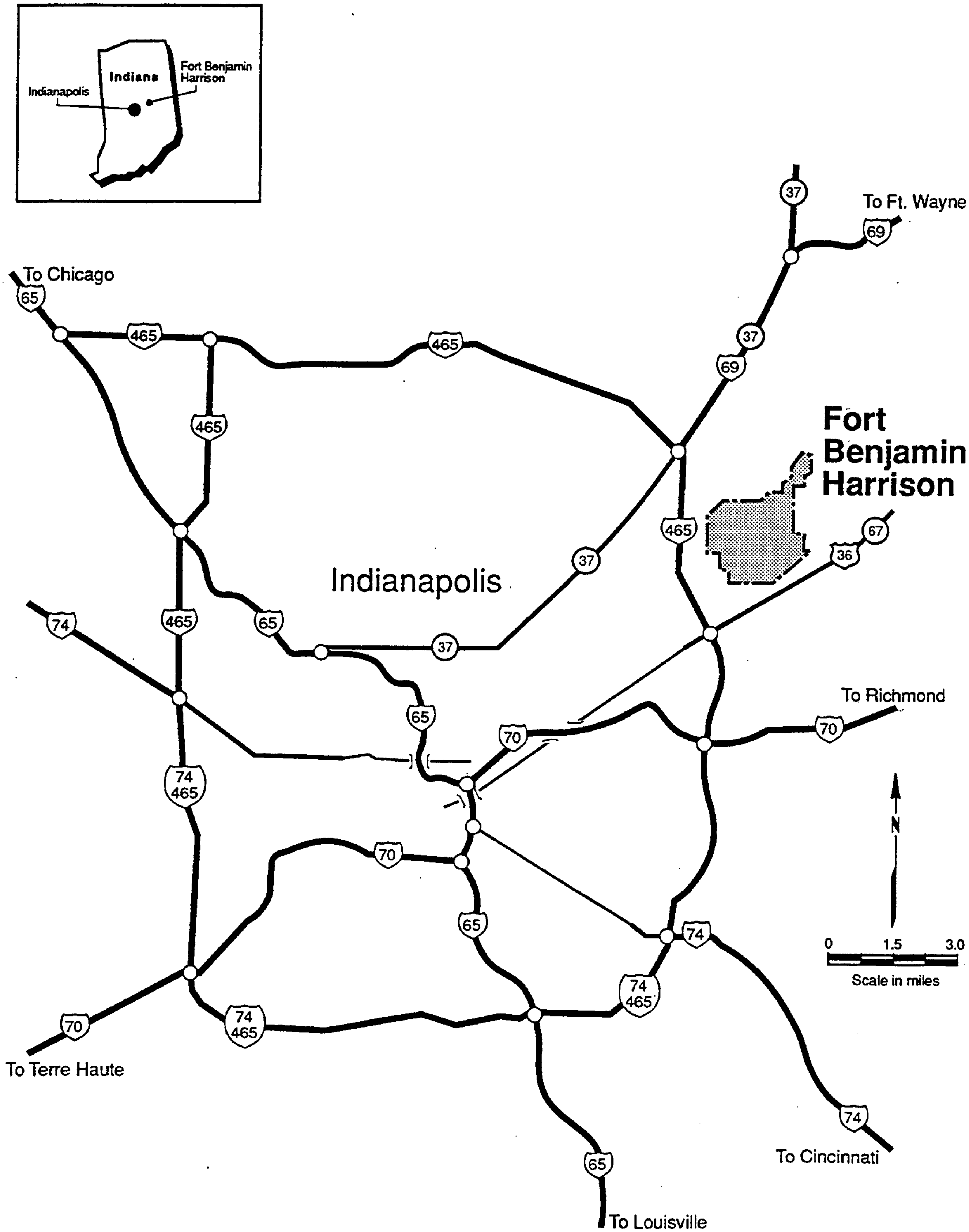
Table ES.3 (continued)

Site Identification	Conclusions	Recommendations for Phase II EI
EI Site SM25c: Historic Military Site - World War I-era dump	This site is located beneath the FBH golf course. Glass bottle fragments were observed in soil excavated from this site. Organic compounds and metals were detected at low concentrations in subsurface soil samples.	Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site SM25d: Historic Military Site - Agricultural dump (Circa 1900) and World War II-era dump	No indication that hazardous substances or hazardous materials were disposed of as waste by the Army at this site.	No further action.
EI Site SM25e: Historic Military Site - Pioneer Homestead and World War II-era dump	No indication that hazardous substances or hazardous materials were disposed of as waste by the Army at this site.	No further action.
EI Site SM25f: Historic Military Site - World War II-era dump	Site is located beneath Lord Hall parking lot. Organic compounds and metals were detected at low concentrations in subsurface soil samples.	Perform a risk assessment to evaluate risks associated with chemicals of concern identified at this site.
EI Site SM25g: Historic Military Site - World War I-era entrenchment used for training activities	No indication that hazardous substances or hazardous materials were disposed of as waste by the Army at this site.	No further action.
EI Site SM25h: Historic Military Site - Military dump in use from 1930 to 1950	Construction debris on the ground surface at this site. Organic compounds and metals were detected at low concentrations in surface soil collected at this site.	Collect surface and subsurface soil samples to assess extent of metals and organic compounds. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site SM25i: Historic Military Site - Water treatment facility once located nearby	Manmade debris was not observed at this site. Organic compounds and metals detected at low concentrations in surface soil collected at this site.	Collect surface and subsurface soil samples to assess extent of metals and organic compounds. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site SM25j: Historic Military Site - World War I-era military dump	Manmade debris was not observed at this site. Organic compounds and metals detected at low concentrations in surface soil collected at this site.	Collect surface and subsurface soil samples to assess extent of metals and organic compounds. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.
EI Site SM25k: Historic Military Site - World War II-era military dump	Household debris was observed at this site. Organic compounds and metals detected at low concentration in surface soil collected at this site.	Perform a risk assessment to evaluate risk associated with chemicals of concern identified at this site.

Table ES.3 (continued)

Site Identification	Conclusions	Recommendations for Phase II EI
EI Site SM25I: Historic Military Site - Former grenade training course	Identified in Community Environmental Response Facilitation Act Report Report (Arthur D. Little, Inc. 1993).	Perform a records search including a review of available aerial photographs. Conduct an unexploded ordnance survey in subsurface soil, and collect surface and subsurface soil samples.
EI Site SM26: Former Sewage Treatment Plant (West of Building 674)	Geophysical survey of area revealed location of possible former structures.	Collect surface and subsurface soil samples to assess nature and extent of constituents possibly present in media at the site. Assess need for collection of groundwater samples.
EI Site SM27: Former Sewage Treatment Plant (north of Building 509)	Geophysical survey of area revealed possible location of construction debris that may be remnants of a former structure.	Collect subsurface soil samples to assess nature and extent of constituents possibly present in soil at the site.
EI Site SM28: Wash Racks, Grease Racks, Oil/Water Separators	One grease rack discharges to ground surface, 3 discharge to a storm sewer. One floor drain and 1 wash rack have no identified discharge point. Two wash racks were pumped out. Remaining facilities discharge to a publicly owned sewage treatment works.	Collect surface and subsurface soil samples to assess nature and extent of constituents possibly present in media at the respective facilities that do not discharge to a publicly owned sewage treatment works. Perform a risk assessment to evaluate risk associated with chemicals of concern identified at the sites.
EI Site SM29: Patriotic Site	Low concentrations of fuel-related organic compounds detected in subsurface soil samples.	Perform a risk screening using ASTM emergency standards for corrective action at petroleum release sites. Remove and dispose of soil posing a risk.

ASTM American Society for Testing and Materials
EI Environmental investigation
PCB Polychlorinated biphenyl
TPH Total Petroleum Hydrocarbon



Harding Lawson Associates
Engineering and Environmental Services

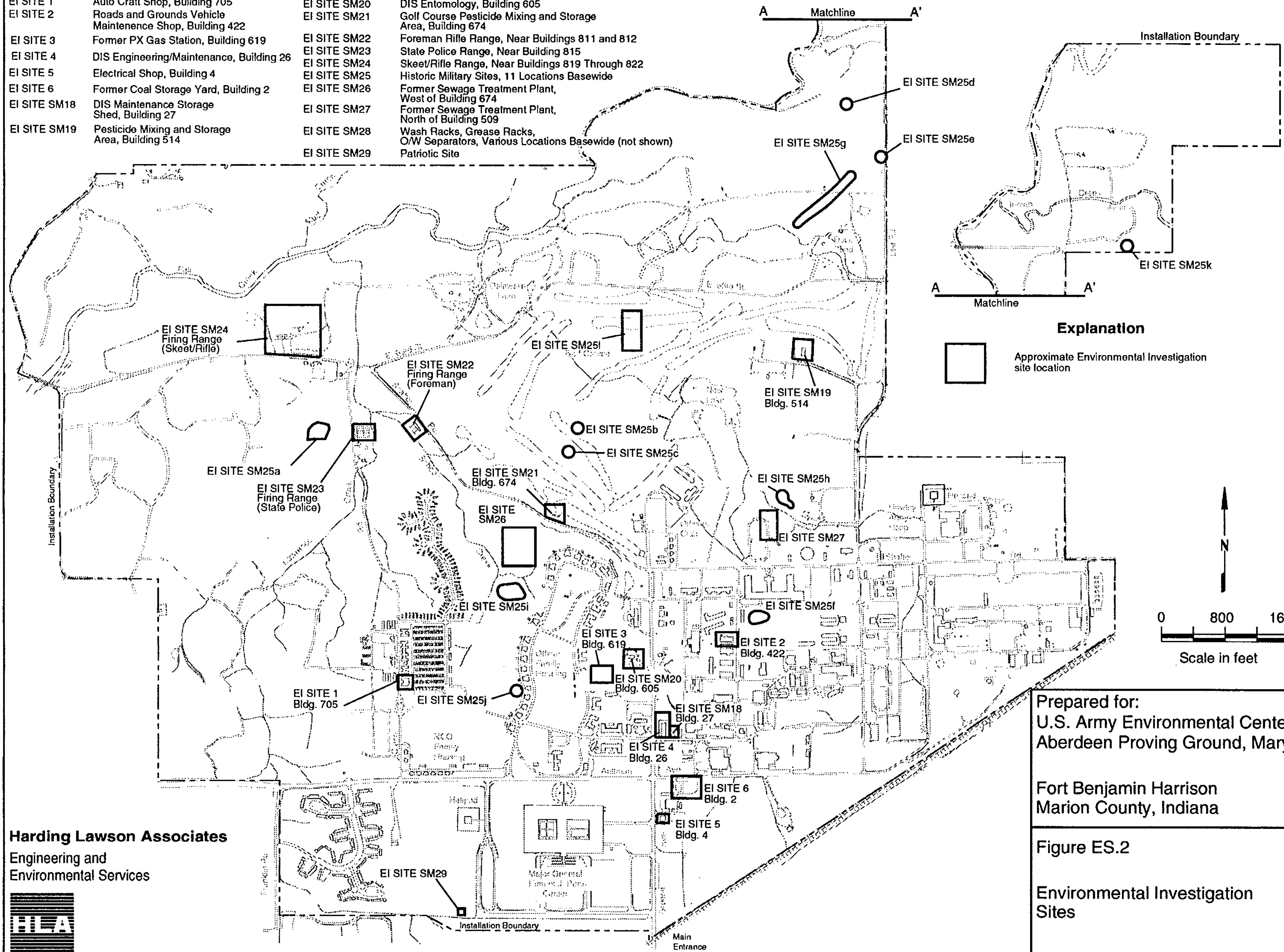
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Fort Benjamin Harrison
Marion County, Indiana

Figure ES.1

Site Location Map

FBH/27359102 9/11/95 LDZ

EI SITE 1	Auto Craft Shop, Building 705
EI SITE 2	Roads and Grounds Vehicle Maintenence Shop, Building 422
EI SITE 3	Former PX Gas Station, Building 619
EI SITE 4	DIS Engineering/Maintenance, Building 26
EI SITE 5	Electrical Shop, Building 4
EI SITE 6	Former Coal Storage Yard, Building 2
EI SITE SM18	DIS Maintenance Storage Shed, Building 27
EI SITE SM19	Pesticide Mixing and Storage Area, Building 514
EI SITE SM20	DIS Entomology, Building 605
EI SITE SM21	Golf Course Pesticide Mixing and Storage Area, Building 674
EI SITE SM22	Foreman Rifle Range, Near Buildings 811 and 812
EI SITE SM23	State Police Range, Near Building 815
EI SITE SM24	Skeet/Rifle Range, Near Buildings 819 Through 822
EI SITE SM25	Historic Military Sites, 11 Locations Basewide
EI SITE SM26	Former Sewage Treatment Plant, West of Building 674
EI SITE SM27	Former Sewage Treatment Plant, North of Building 509
EI SITE SM28	Wash Racks, Grease Racks, O/W Separators, Various Locations Basewide (not shown)
EI SITE SM29	Patriotic Site



Explanation

Approximate Environmental Investigation site location

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Engineering and
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Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Fort Benjamin Harrison
Marion County, Indiana

Figure ES.2

Environmental Investigation
Sites

1.0 INTRODUCTION

This Environmental Investigation (EI) report has been prepared by Harding Lawson Associates (HLA) for the U.S. Army Environmental Center (USAEC) to fulfill requirements of the U.S. Department of the Army (Army) under Total Environmental Program Support (TEPS) Contract DAAA15-91-D-0013, Delivery Order 0004 (Task 4) for the U.S. Army Soldier Support Center (USASSC). The USASSC is at Fort Benjamin Harrison (FBH) in Lawrence Township, Marion County, Indiana. Investigations conducted by HLA at FBH include both the EI activities conducted at non-Resource Conservation and Recovery Act (RCRA) sites and RCRA Facility Investigation (RFI) activities conducted at RCRA solid waste management units (SWMUs). This report presents the results of the Phase I EI field program. Results of the RFI site investigations were provided in a separate report (HLA, 1994b).

This document was prepared by HLA at the direction of USAEC for the sole use of USAEC and the members of the FBH Base Realignment and Closure (BRAC) Cleanup Team, including the Army, the U.S. Environmental Protection Agency Region V (EPA), and the Indiana Department of Environmental Management (IDEM), the only intended beneficiaries of this work. No other party should rely on the information contained herein without the prior written consent of HLA.

1.1 Environmental Investigation Purpose and Objectives

The sites investigated during the FBH EI were identified as areas requiring environmental evaluation (AREEs) in the Enhanced Preliminary Assessment (PA) for FBH (Roy F. Weston [Weston], 1992) or subsequently added by the Army. (Additional information regarding the Enhanced PA is provided in Section 2.0.) The purposes of the EI are to (1) obtain site-specific information to confirm or deny the presence of releases of hazardous substances and (2) assess the nature and extent of the hazardous substances released for possible remedial action and clearance of the EI sites for property transfer.

As discussed below, the EI is being conducted in two phases. The objectives of the Phase I EI are as follows:

- Provide background concentrations of chemicals in surface soil, subsurface soil, and groundwater at FBH.
- Evaluate whether a release of hazardous substances has occurred at each EI site.
- Assess the nature of hazardous substance releases and the media affected.

The results of the Phase I EI will also provide the basis for subsequent Phase II EI activities including additional site investigation, evaluation of potential risks to human health and the environment, and, where appropriate, selection of site remediation technologies.

1.2 Environmental Investigation Approach

The EI for FBH is being conducted in two phases to address releases or suspected releases of hazardous substances. Upon review of Phase I field work and analytical data results, Phase II field work and analytical data will be used to (1) more fully characterize the nature and extent of contamination at each EI site, where necessary, for which the Phase I data indicate a release of hazardous substances has occurred, (2) support the baseline human health and environmental risk assessment, and (3) support an alternatives analysis (AA) at selected EI sites.

The Phase I EI at FBH involved the investigation of 28 EI sites according to the approved Technical Sampling Plan (TSP) (HLA, 1993a). The Phase I EI sample analytical results were compared to background concentrations and maximum contaminant levels (MCLs). At EI sites where no release of hazardous substances occurred, no further action is recommended. Additional activities (including Phase II investigation, interim actions, and a baseline risk assessment, as appropriate) are recommended at EI sites where a release has occurred.

1.3 Report Organization

Section 2.0 presents background information for FBH and the surrounding area, including physical characteristics of the study area, operations history, regulatory history, and a summary of previous investigations. Section 3.0 presents a summary of investigation activities, the background sample analytical results, the analytical program, the evaluation process, basewide geology, and basewide

hydrogeology. Section 4.0 provides site descriptions, investigation activities, findings, conclusions, and recommendations for each EI site. Section 5.0 presents a report summary including conclusions and recommendations. A list of acronyms and abbreviations and a list of references used in this report are presented in Sections 6.0 and 7.0, respectively. Tables and figures for each section of the report are located at the end of each respective section. Supporting data and documentation are provided in the following appendixes:

Appendix	Contents
A	Soil-Gas Survey Results
B	PCB Screening of Surface Soil
C	Investigative Samples Analytical Results
D	Background Samples Analytical Results
E	Analytical Data Quality Assessment
F	Field Documentation
G	Surface Soil Sample Descriptions
H	Boring Logs and Well Construction Diagrams
I	Stream Discharge Calculations
J	Bullet Fragment Analysis
K	Geophysical Methods, Equipment, and Field Procedures
L	Historic Military Site Photographs
M	Responses to Comments Regarding the Draft Phase I Environmental Investigation Report and RCRA Facility Investigation Report
N	Responses to Comments Regarding the Final Phase I Environmental Investigation Report

2.0 BACKGROUND

This section provides a brief summary of the FBH location, environmental setting, history, and current operations at the installation. This information was extracted from the Enhanced PA (Weston, 1992) except where otherwise referenced.

2.1 Physical Characteristics of the Study Area

FBH is an Army installation consisting of approximately 2501 acres, located within Lawrence Township, Marion County, in central Indiana. The installation is approximately 12 miles northeast of downtown Indianapolis, as shown in Figure 2.1. The 2501 acres of the installation are located in portions of 11 contiguous sections consisting of the following: Sections 29, 30, and 31 of Township 17 North, Range 5 East; Sections 35 and 36 of Township 17 North, Range 4 East; Section 1 of Township 16 North, Range 4 East; and Sections 4, 5, 6, 7, and 8 of Township 16 North, Range 5 East.

In 1986, Lawrence Township had a population of approximately 83,000. Indianapolis, the twelfth largest city in the United States, has a 1990 population of 737,000 in the city; 791,000 in Marion County; and 1,252,400 in the metropolitan area (Weston, 1992). Marion County is located in the geographic center of the State of Indiana. FBH is bounded by residential areas and farmland, with the exception of light industrial areas that border FBH to the southeast.

The following sections describe the general physiography, geology, hydrogeology, meteorology, and ecology of the area. More site-specific geology and hydrogeology, based on the results of Phase I RFI and EI activities at FBH, are presented in Sections 3.5 and 3.6.

2.1.1 Physiography

FBH is situated on the Tipton Till Plain, which lies in the Till Plains Section of the Central Lowland physiographic province. This till unit is of glacial origin, dating back to the Wisconsinian age. The topography rises (north to south) from nearly level bottomland along Fall Creek and its tributaries across moderately sloping terraces to nearly level uplands. Fall Creek and its tributaries have

erosionally formed the sloping terraces and incised steep-walled ravines. Surface elevations across FBH range from 732 feet above National Geodetic Vertical Datum of 1929 (NGVD) along the northern boundary of the installation to 870 feet NGVD at the southern boundary.

2.1.2 Geology

The discussion of the general geology of the area near FBH has been divided into three topics; (1) seismicity, (2) surficial geology, and (3) bedrock geology. These three topics are discussed in the following subsections.

2.1.2.1 Seismicity

Three seismic regions have the greatest effect on the seismicity of Indiana. These three seismic regions are the New Madrid fault zone located approximately 200 miles to the southwest, the Wabash River Valley fault zone located in southwestern Indiana and southeastern Illinois, and the Western Ohio seismic region. Historically, the central portion of Indiana has only been slightly affected by seismic activity (West and Warder, 1983). The area surrounding FBH has been categorized as an area of least seismic risk in two publications: Algermissen's "Seismic Risk Map of the United States" (1969) and Nuttli's "Assessing Earthquake Hazards in the United States" (1973).

The seismic history of Indiana is dominated by large regional earthquakes with epicenters in western Kentucky, southern Illinois, and eastern Missouri. Some earthquakes with epicenters in western Ohio have also been felt in parts of Indiana. According to Kovacs and Murphy (1977), only 12 historical earthquakes of epicentral intensity V (Mercali Scale) or greater have originated within Indiana. A 1909 earthquake of intensity VII centered near the Illinois border south of Terre Haute, Indiana, was the most damaging earthquake that has occurred in the state (Earthquake Information Bulletin, 1972). Blakely and Varma (1976) show return periods of 3.5, 18, and 100 years between consecutive earthquakes yielding intensities of IV, VI, and VII, respectively. At the present time, neither the State of Indiana nor the City of Indianapolis have any building code provision relative to seismic design (West and Warder, 1983).

2.1.2.2 Surficial Geology and Soil

The surficial geology at FBH consists of recent and Pleistocene unconsolidated deposits that unconformably overlie Middle Devonian and Silurian limestone and dolomite bedrock units. The unconsolidated deposits are generally made up of two units: the Martinsville Formation (recent alluvium; silts, sands, and gravels) and the Trafalgar Formation (Kansan-, Illinoisan-, and Wisconsinian-age glaciofluvial and glacial till deposits). The till is generally a mixture of gravel, sand, and silt in a clayey matrix. Only the most recent Wisconsinian-aged till is exposed at the surface. The unconsolidated deposits reach their maximum thickness in bedrock valleys that were scoured during the periods of glaciation and later filled with deposits from glacial meltwater. Bedrock valleys filled with remnant deposits of these glacial meltwater streams have been identified in the vicinity of FBH along Fall Creek.

The soil types found at FBH have been evaluated and grouped into three categories according to their physiographic locations (Weston, 1992). These categories include bottomland, terrace, and upland soil. Bottomland soil is primarily found in the northern portion of FBH. This soil consists of recent alluvial materials found along the floodplain of Fall Creek and its tributaries. Bottomland areas are subject to flooding. The bottomland soil type belongs to the Genesee group, consisting of deep, well-drained soil with a medium to coarse texture. Bottomland soil is low in organic matter and retains a high moisture capacity. Permeability is moderate, and runoff is low for bottomland soil because of the shallow slopes of less than 2 percent.

Terrace soil is found primarily in the middle portion of FBH in upland areas adjacent to the bottomland soil. This soil type includes the Miami, Fox, and Ockley soil series. Miami soil has developed in glacial till and is found on nearly level upland till plains. In contrast, Fox and Ockley soil types have developed from glacial and sandy outwash materials, respectively, and are found on outwash plains and terraces. The Fox series is found generally on level to moderately level terrain, and the Ockley series is found on gently sloping terrain. The terrace soil is deep and well drained

with moderately coarse textured materials near the surface. The subsoil grades to a moderately fine textured material that changes abruptly to sand and gravel at depths of 2 to 6 feet below ground surface (bgs). The susceptibility of terrace soil to erosion depends on the degree of the slope (2 to 25 percent) and the amount of disturbance (exposed soil). Medium to low in organic matter, this soil type generally retains a low to moderate moisture capacity.

Upland soil, found near the southern and eastern boundaries of FBH, includes the Brookston, Crosby, and Hennepin soil series. These are deep, poorly drained (Brookston series) to well-drained (Hennepin series) soil types, with moderately fine-textured surface and subsurface materials. The Brookston soil is high in organic matter and has a high available moisture capacity. The Crosby and Hennepin soil types exhibit less organic matter with a consequently lower moisture content than the Brookston soil. Slopes in the upland areas are generally in the 0 to 2 percent range. This range in slope indicates less potential for erosion than the slopes observed in the terrace soil. Some upland soil slopes within FBH do, however, exceed 25 percent. Although these slopes have a high potential for erosion, the steep slopes place severe limitations on the use of these areas.

2.1.2.3 Bedrock Geology

The top of bedrock at FBH lies at depths of approximately 150 to 250 feet bgs. Silurian-aged rocks subcrop beneath surficial deposits in the northwest portion of the installation. These rocks consist of white/gray limestone, tan dolomite, and blue shale and exceed 150 feet in thickness. Devonian-aged rocks, which subcrop beneath surficial deposits in the remainder of the installation, consist of white/blue limestone, tan dolomite, and blue/black shale. The regional dip of these two formations is to the southwest at approximately 0.27 degree or 25 feet per mile (U.S. Army Environmental Hygiene Agency [AEHA], 1986). A bedrock geologic map and generalized geologic cross section of FBH and vicinity are presented in Figure 2.2.

2.1.3 Hydrogeology

The general hydrogeology of the area near FBH has been divided into three areas of discussion; (1) surface water, (2) groundwater, and (3) water supply. These three areas are discussed in the following subsections.

2.1.3.1 Surface Water

Surface drainage (Figures 2.3 and 2.4) from the installation is primarily to the northwest, ultimately entering Fall Creek. Four major streams (Fall Creek, Lawrence Creek, Mud Creek, and Indian Creek) and three intermittent streams (Camp Creek, Fort Branch, and Schoen Creek) constitute the surface drainage system on FBH. Surface-water runoff is discharged to these streams from storm sewers in adjacent developed areas. Three reservoirs (Delaware Lake, New Lake, and Duck Pond) have been constructed on the installation (Figure 2.3). These three reservoirs are stocked with fish and are designated as fishing and recreational areas. Geist Reservoir (Figure 2.3) supplies drinking water to the City of Indianapolis and surrounding communities and is located approximately 1.5 miles upstream from FBH.

The Indiana Stream Pollution Control Board has classified the surface water at FBH as suitable for recreational use and aquatic life; therefore, this water is subject to the corresponding water quality criteria for this designation. In addition to these criteria, Fall Creek is also subject to more restrictive limitations on specific maximum chemical concentrations because it is used as a water-supply source for the City of Indianapolis. Samples of Fall Creek and nearby surface-water bodies both on and adjacent to FBH have been collected since the early 1970s. Analytical results from these samples indicate that the water quality is good and suitable for the uses for which it has been designated. A review of available sample results indicates that the operations at FBH appear to have had a negligible impact on the primary streams in the vicinity of the installation.

FBH personnel, in conjunction with the U.S. Fish and Wildlife Service (USFWS) (Tom Shafer, Chief, Natural Resources Management Division, FBH, oral commun., 1993), have identified wetlands at FBH using the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" (Federal Interagency Committee for Wetland Delineation, 1989). Although these wetlands were identified using the field manual, they have not been completely delineated. In addition, according to FBH personnel, two areas at the installation are being considered for restoration to wetlands by FBH personnel and the State of Indiana. Wetlands are expected to be constructed upon delineation of the area(s) and approval of environmental restoration funds. Wetlands are shown in Figure 2.4.

2.1.3.2 Groundwater

Groundwater in the FBH vicinity is available for drinking water-supply purposes from both the unconsolidated and the underlying bedrock. The primary groundwater flow direction within these formations is northwest toward Fall Creek. Geist Reservoir, situated to the northeast of FBH, has caused water levels in the immediate vicinity of the reservoir to be somewhat higher than expected if the reservoir was not present. Groundwater flows from the relatively higher water-level area at Geist Reservoir toward Fall Creek.

The primary source of water for FBH is an unconfined sand and gravel aquifer that underlies White River and Fall Creek. White River parallels Fall Creek approximately 5 miles northwest of FBH. The location of this aquifer generally follows the glacial meltwater and outwash deposits previously mapped along these streams. This deposit is referred to as the glacial-outwash aquifer and is considered the most important aquifer in the area. The aquifer varies in extent and thickness but is relatively thin (approximately 20 feet thick). The contribution by Fall Creek to the underlying aquifer is uncertain. However, deposits in the creek that overlie the sand and gravel aquifer are believed to prevent large quantities of surface water from entering the aquifer (EPA, 1991b).

A bedrock aquifer lies just beneath the glacial-outwash aquifer at an average depth of 170 to 250 feet bgs. Wherever the bedrock aquifer system occurs, the highest yield of water is usually found within the first 100 feet of bedrock (EPA, 1991b).

Highly localized perched water tables are present within the glacial till and are associated with small lenses of sand and gravel. Perched water tables are common to glacial soil (till plain) areas. Because of the perched water, springs and seeps are common throughout the installation (EPA, 1991b).

Twenty-nine monitoring wells were previously installed in several areas at FBH (Figure 2.4), including the Former Sanitary Landfill (East) (excessed to the City of Lawrence), the Former Sanitary Landfill (West), the electrical shop (Building 4) and heating plant (Buildings 2 and 3), the Former Sewage Treatment Plant (Building 810), and most recently, on the site of the Learning Resource Center (Former Drum Storage Area). Samples from selected wells (adjacent to the two landfills) have been collected for analysis since the early 1980s.

Analytical results indicate that there are some localized effects from the eastern landfill on the groundwater quality at FBH (AEHA, 1990). In a groundwater sample collected from Well MW20 (near the eastern landfill) in 1990, six volatile organic compounds (VOCs) were detected, and vinyl chloride exceeded the primary drinking water standard of 2 micrograms per liter (μg/l). The concentration of total dissolved solids was above the secondary drinking water standard of 500 milligrams per liter (mg/l) in samples collected during 1990 from Wells MW16, MW17, MW20, and MW22. Dissolved iron was found to exceed the secondary drinking water standard of 300 μg/l in the MW20 sample, and the background concentration of dissolved manganese was assessed as being high because of the glacial till soils. High metals concentrations in samples from Wells MW17, MW20, and MW22 were attributed to effects from the eastern landfill (AEHA, 1990).

The western landfill was assessed as affecting local groundwater quality, based on the increase in metals (iron and magnesium) and total dissolved solids concentrations in samples from downgradient wells (MW2, MW3, MW4, and MW5) collected in 1986. No organics were detected in samples from either upgradient or downgradient wells near the western landfill (AEHA, 1987). The Army is monitoring groundwater, collected from monitoring wells located near the western landfill, under a separate program. The landfills were not investigated during the EI.

2.1.3.3 Water Supply

Three public water-supply systems in the vicinity of FBH that draw their drinking water from the above-mentioned aquifers are (1) the Indianapolis Water Company (IWC), (2) the City of Lawrence Water Company, and (3) FBH. The IWC withdraws a portion of its total water supply from well fields located along Fall Creek. These well fields include the Fairwood Hills and the Geist Area Well Fields, which in 1989 had an anticipated yield of 20 to 25 million gallons per day (mgd). Similarly, the City of Lawrence withdraws its drinking water from well fields that yield water from both the glacial till aquifer and the bedrock aquifers. These well fields have a combined anticipated yield of 7 mgd and are distributed throughout the municipality. FBH's drinking water is supplied by the well field located in the northern extremity of the installation (Figure 2.4). There are six wells in this area; three are currently operational for daily use (Wells 9, 10, and 11), associated with Buildings 516, 528, and 541, respectively, and the other three water-supply wells (Wells 6, 7, and 8) are apparently inactive. Groundwater production and use at FBH is estimated at 1 mgd.

Six onpost water-supply wells were previously completed at the location of the FBH well field presented in Figure 2.4. Supply wells drilled into the thick alluvial and glacial outwash material along Fall Creek are the best producers, with well yields as high as 500 gallons per minute (gpm). Small shallow wells (70 to 150 feet deep) located in the sand and gravel aquifers currently produce between 100 and 400 gpm, in contrast to yields from the deep bedrock wells that range from as little as 30 gpm to as much as 1200 gpm.

Water levels measured in these supply wells differ greatly between those that draw from the glacial till and those that draw from bedrock aquifers. Water levels in wells completed in the glacial till range from 13 to 21 feet bgs, while water levels from nearby bedrock wells exhibit a range of 103 to 134 feet bgs.

Groundwater in the vicinity of FBH contains calcium, bicarbonate, iron, chloride, magnesium, and moderate concentrations of total dissolved solids (TDS). Specific conductivity and TDS average 740 micromhos per centimeter (μmhos/cm) and 432 mg/l, respectively. Although the water is of acceptable quality for most uses, it is classified as hard to very hard. Average hardness of the untreated water at FBH is 230 mg/l (as calcium carbonate). The difference in groundwater quality between the glacial-outwash aquifer and the bedrock aquifer is negligible (U.S. Army Corps of Engineers [COE], 1990; State of Indiana Department of Natural Resources [IDNR], 1980).

2.1.4 Meteorology

FBH has a continental climate characterized generally by warm and humid summers and moderately cold winters. Temperatures average 28 degrees Fahrenheit (°F) in January and 75°F in July. The summer climate is influenced by warm, moist air masses from the Gulf of Mexico that move up the Mississippi and Ohio valleys. The winter climate is influenced by cold, dry air masses from Canada that move across the plains (Indianapolis Chamber of Commerce, 1990).

Precipitation in central Indiana is distributed fairly evenly throughout the year. The average annual rainfall is 40 inches, and the average annual snowfall is 23 inches. During the summer months, crops may be damaged from periods of drought. Central Indiana is occasionally subject to tornadoes and windstorms. Winds blow predominantly from the southwest in the summer and from the northwest in the winter. The average annual wind velocity at FBH is 9.7 miles per hour (Indianapolis Chamber of Commerce, 1990).

2.1.5 Ecology

Several recent biota surveys have been conducted at FBH. IDNR conducted a survey of special plant species and natural areas (Hedge and others, 1992), the USFWS conducted a fish and wildlife survey (USFWS, 1992), and the Audobon Society conducted a survey of resident and nesting birds (Jackson, 1992). The discussion of the flora and fauna of FBH, presented in this section, is based on information presented in these reports. Table 2.1 summarizes the regulatory and administrative status of sensitive plant and animal species known to occur or potentially occurring at FBH. Table 2.1 was originally developed on the basis of sensitive species information presented in the 1992 biota surveys. This table has been updated and reflects current federal and state status assigned to these species.

2.1.5.1 Flora

Approximately 1069 acres at FBH are covered by woodlands. The dominant species of trees in the woodlands include red oak, green ash, sugar maple, American beech, black walnut, and cottonwood. Developed areas are covered with lawn grasses and various ornamental and shade trees, including tulip, sweet gum, honey locust, Ohio buckeye, and several varieties of hawthorn and crabapple trees.

The woodlands at FBH are maintained through periodic single tree and group harvesting and are replenished through natural regeneration and planting. Thirty-six areas of harvestable timber stands exist at FBH, generally to the west, north, and northeast of developed areas. Each area ranges in size from 9 to 79 acres. Timber is not routinely harvested at FBH; however, from 1959 to 1970, approximately 750,000 board feet of timber were harvested. Firewood is sold by permit to FBH personnel and their dependents. There have been no major forest fires recorded at FBH.

Four sensitive plant species were identified at nine locations (Figure 2.4) at FBH during a 1991 field survey (Hedge and others, 1992), Wood's sedge (*Carex woodii*), pink turtlehead (*Chelone oblique* var. *speciosa*), goldenseal (*Hydrastis canadensis*), and ginseng (*Panax quinquefolius*) are considered state

"watch list" species that may become threatened or endangered in the future (Table 2.1). Wood's sedge occurs in the floodplains at FBH, pink turtlehead occurs in the low woods and floodplains, goldenseal occurs in rich mezic upland or floodplain forests, and ginseng grows in rich soil in dry to mezic upland forest of FBH.

2.1.5.2 Fauna

The primary game species at FBH include the fox squirrel, whitetail deer, bobwhite quail, and mourning dove. Game fish found in the three man-made lakes onpost (Delaware Lake, New Lake, and Duck Pond) include the largemouth bass, bluegill, channel catfish, crappie, bullhead, and trout. These lakes are periodically stocked with bluegill, crappie, bass, and catfish.

Sensitive animal species that have been observed at FBH include four state endangered birds, seven state special concern birds, and the federally endangered Indiana bat, which is the only federally listed animal species known to inhabit FBH. Populations of the Indiana bat concentrate in caves in the southern portion of Indiana for winter hibernation. In the spring, the female bats disperse to establish reproductive colonies and to feed in old-growth riparian and floodplain forests, including those at FBH (Figure 2.4). Females give birth to a single young in June or early July. Indiana bat populations have declined considerably between 1960 and 1990 because of vandalism, modifications and disturbance of caves, and loss of summer habitat.

Four state-endangered birds, including the northern harrier (*Circus cyaneus*), upland sandpiper (*Bartramia longicauda*), black tern (*Childonias niger*), and golden-winged warbler (*Vermivora chrysoptera*), were observed as migrants or were observed during foraging activities at FBH in 1984 (USFWS, 1992). These species were not reported during the more recent bird survey conducted in 1991 (Jackson, 1992). The great blue heron, broad-winged hawk, red-shouldered hawk, and hooded warbler are state special concern birds that were observed at FBH during the 1991 field survey (Jackson, 1992).

A great blue heron rookery is located along the Indian Creek floodplain, approximately 1/2 mile upstream of its confluence with Fall Creek, in the northeastern portion of FBH. Great blue heron rookeries in Indiana are restricted to tall trees in secluded forested areas near water. Excessive disturbances, especially during nesting season, will result in the abandonment of rookeries. The nesting season for great blue heron begins in early April and lasts through late June, when fledglings are released from nests.

Habitat for the broad-winged hawk is in upland and bottomland forests near lakes and wetlands at FBH. The red-shouldered hawk is more wide ranging, inhabiting the same areas as the broad-winged hawk in addition to open fields and grasslands. Hooded warblers were observed in a wetland area in the northwest corner of FBH (Jackson, 1992).

Kirtland's snake (*Clonophis kirtlandii*) and the eastern sand darter (*Etheostoma pellucida*) are two animal species reported in Marion County that are currently Category 2 candidates for the federally endangered/threatened species list. Kirtland's snake is also a state threatened species, and the eastern sand darter is a state species of special concern. Although these species have not been documented at FBH, the potential for their presence exists (USFWS, 1992).

2.2 History

The history of FBH is divided into two discussions: the operational history and the archaeological and historically significant areas. These discussions are provided in the following subsections.

2.2.1 Operational History

FBH was created by an act of the U.S. Congress on March 3, 1903. Initially established as an infantry regiment post, it became a World War I training camp for officers and engineers. During the years between World War I and World War II, FBH was used by the Army as a training center for military personnel and civilians. From 1941 to 1945, FBH became the site of an induction and reception center for military draftees, home to several Army schools, a prisoner of war camp, an

Army disciplinary barracks, and a 1000-bed hospital. In 1947, FBH was officially declared "United States Army surplus." In October 1948, FBH was relinquished to the 10th Air Force for use as an Air Force base; however, the facilities were inadequate for use as an Air Force base. In April 1950, command of FBH was returned to the Army. FBH was reactivated in the 1950s as the Army Finance Center. Gates-Lord Hall was completed in February 1957 to house the new Adjutant General and Finance Schools.

Activities that followed the opening of the Army Finance Center can be characterized as administration and training. In 1980, FBH was reorganized and designated as the USASSC, responsible for personnel service support including finance, religion, legal aid, music, public affairs, morale, welfare, and recreation. The USASSC houses five major tenant commands including the Defense Finance and Accounting Service - Indianapolis Center, the Enlisted Records and Evaluation Center, Hawley Army Community Hospital, Readiness Group Harrison, and the 123rd Army Reserve Command (ARCOM).

In 1991, FBH was placed on the U.S. Department of Defense's Base Closure List. The 1991 Defense Closure and Realignment Commission recommended that FBH close by 1997. Property disposal and reuse activities associated with the closure of the installation were initiated in October 1991 and have continued to the present. One 144-acre parcel, the U.S. Army Reserve Component Enclave in the southeastern part of the installation at FBH, will be retained by the Army after transfer of the remainder of the installation.

2.2.2 Archaeological and Historically Significant Areas

Several archeological investigations have been performed at FBH as part of a cultural resources program that began in 1985. Individual investigations are conducted before major land improvements at FBH. The latest archeological investigation, conducted in late 1989 and early 1990, identified six new archeological sites at FBH: four prehistoric and two historic. Table 2.2 summarizes the archeological sites identified at FBH.

Historical investigations at FBH have identified more than 100 buildings with historical and military significance. Currently, one building at the post (Building 616, the post office) is listed on the National Register of Historic Places. The nomination for establishing a historic district at FBH has been forwarded to the Department of the Interior from the office of the Deputy Secretary of the Army (Environment, Safety and Occupational Health). The proposed historic district includes primarily the Lawton Loop and Sergeants' Row housing areas (including 75 buildings, 1 site, and 3 structures).

2.3 Regulatory History

In September 1987, USASSC submitted an application for a RCRA permit to operate a storage facility at the Defense Reutilization and Marketing Office (DRMO). As a result of this application, a RCRA Facility Assessment (RFA) was performed by EPA (EPA, 1991b). The RFA that was conducted identified several SWMUs at FBH. SWMUs are sources or potential sources of a release of hazardous waste or hazardous constituents to the environment. The RCRA permit (EPA identification number IN4 210 090 003) was issued in September 1991, in part by EPA, and in part by IDEM (EPA, 1991a). The RCRA permit identified seven SWMUs requiring corrective action and directed the USASSC to perform an RFI at these SWMUs.

In March 1989, USAEC (previously the U.S. Army Toxic and Hazardous Materials Agency [USATHAMA]) was assigned the responsibility for centrally managing the BRAC Program. As a result of the closure program for FBH, environmental studies are being performed relevant to property transfer and will conclude, if necessary, in remedial action before transfer of property at FBH.

In October 1991, USAEC conducted an Enhanced PA (Weston, 1992) for FBH as a precursor to a possible remedial investigation/feasibility study (RI/FS). The study identified AREEs, their impact on the surrounding environment, and any immediate necessary actions. Samples were not collected from any media during the assessment.

The Enhanced PA (Weston, 1992) identified 36 AREEs. The Enhanced PA was primarily based on the environmental conditions observed at FBH during the period of the study. Past site conditions and management practices were evaluated on the basis of readily available records and the recollections of people interviewed. Possible sources of contamination were identified, and recommendations were made for a follow-up investigation. The 36 AREEs identified in the Enhanced PA, the Enhanced PA recommendation for each AREE, and the current disposition of each AREE are summarized in Table 2.3.

HLA prepared a Final TSP for the Phase I EI at FBH based on the Enhanced PA and other information gathered during an initial site visit conducted by the Army and HLA from September 29 to October 2, 1992 (HLA, 1992). The TSP included proposed field investigation activities for sites identified as AREEs and recommended for investigation in the Enhanced PA. In addition, at the direction of the Army, the TSP included information for investigations at 11 historic military sites and the "Patriotic Site." The Phase I EI Field Investigations were completed during the spring of 1994.

At the direction of EPA, sites subject to other regulatory programs with state or federal lead such as the Former Sanitary Landfill, which is subject to the state solid waste program, or underground storage tanks (USTs), which are subject to the state UST/LUST (leaking underground storage tanks) regulatory program, were not evaluated during the Phase I EI and are addressed under other Army environmental programs. Five of the SWMUs identified in the Army's RCRA permit are addressed in the Phase I RFI (HLA, 1994b). The other two SWMUs are subject to other state lead regulatory programs. Sites investigated during the Phase I EI and discussed in this report are listed in Table 2.4.

Since the approval of the TSP (HLA, 1993a), one additional site has been identified at FBH. This site, the Historic Grenade Course, was identified in the draft Community Environmental Response

Facilitation Act (CERFA) report (Arthur D. Little, Inc., 1993). No investigation activities were conducted at this site during the Phase I EI. However, the site has been added to the list of historic military sites (EI Site SM25l), and investigation of this site is included in the proposed Phase II EI activities.

The State of Indiana is currently in the process of purchasing the FBH golf course. Three Phase I EI sites, historic military Sites SM25b, SM25c, and SM25l, are located on the golf course. As a result of environmental concerns by IDEM, these sites are being withheld from the property transfer pending further investigation. The Army is evaluating the Historic Grenade Course (SM25l). An expedited Phase II EI for the other two sites is currently being conducted by Science Applications International Corporation (SAIC). After the Phase II EI activities and any required remedial action are completed, the sites will be transferred to the state.

2.4 Summary of Previous Investigations

Numerous environmental studies have been conducted at FBH. Some of these studies are area-specific, while others are basewide investigations. In some instances, information indicates a particular study was conducted, yet no report was found during the site visit. The following chronological list of studies was extracted from the Enhanced PA (Weston, 1992) except where otherwise referenced.

- The *Water Quality Monitoring Consultations No. 24-L-08-75/76 for Fort Benjamin Harrison, Indiana*, was completed by the U.S. Army Environmental Hygiene Agency (AEHA), Aberdeen Proving Ground, Maryland, in September 1975 (AEHA, 1975). This document summarizes the monthly collection of surface-water samples from 11 sampling location from October 1973 through April 1975. Although personnel shortages caused the sampling program to be operated sporadically, the general quality of surface water on or adjacent to the installation is assessed as good to excellent. No recommendations were made for continued sampling of these locations.

- The *Water Quality Engineering Consultation (WC) No. 32-24-0237-80, Fort Benjamin Harrison, Indiana*, was completed by AEHA in July 1980 (AEHA, 1980). The objective of this survey was to assess the impact of FBH activities on the levels of pesticides and polychlorinated biphenyls (PCBs) in Fall Creek (as identified in the 1971 Draft Environmental Impact Statement [EIS]). The results of the sampling and analysis indicate no evidence that FBH is

contributing significant levels of pesticides or PCBs to Fall Creek and recommended that the final EIS reflect this conclusion.

- The *Army Pollution Abatement Program Study, Installation of Monitoring Wells, Fort Benjamin Harrison, Indiana*, was completed by AEHA (Control No. 81-26-8255-81) in June 1981. This document summarizes the installation of monitoring wells and soil borings adjacent to the active sanitary landfill (located in the western portion of the base off Glenn Road). No conclusions were rendered.

- The *Potable/Recreational Water Quality Survey No. 31-610103-82, Fort Benjamin Harrison, Indiana*, was completed by AEHA in April 1982 (AEHA, 1982). This survey was conducted to evaluate the water supply, water treatment, and water distribution system at FBH. It was determined that the Fall Creek Valley well field yields an adequate supply for the installation and that the water treatment plant produces a potable water supply that meets all water quality regulatory requirements. Recommendations included notifying users of the high sodium content, providing low-sodium water to certain individuals, proper plugging and sealing of abandoned wells, and the development of a standard operating procedure for user notification during an emergency.

- The *Installation Assessment of Fort Benjamin Harrison, Indiana, Report No. 331* was submitted by Environmental Science & Engineering, Inc. (ESE), to AEHA in January 1984 (ESE, 1984). This onsite installation assessment was conducted between October 25 and 29, 1982, to address past and present use of any toxic or hazardous materials and to assess the potential for offpost migration. The study identified two wash racks as potential contaminant sources due to their direct tie into the storm sewer system. In addition, available information on geology, contaminant sources, and limited water quality data did not indicate any offpost migration of contaminants via surface or groundwater. No follow-up survey was recommended.

- The *Environmental Assessment of Ongoing Mission, Fort Benjamin Harrison, Indiana*, was completed by the U.S. Army Training and Doctrine Command (TRADOC) in March 1984 (TRADOC, 1984). The purpose of this study was to assess whether an EIS was required and to identify measures to mitigate adverse environmental impacts. The conclusion was that no significant environmental impact occurs as a result of the ongoing mission activities and that an EIS is not required.

- The *Groundwater Potential Contamination Survey No. 38-26-0910-86, Fort Benjamin Harrison, Indiana*, was conducted by AEHA in April 1986 (AEHA, 1986). This document summarizes the findings of an installationwide investigation with respect to potential sources of groundwater contamination (such as landfills, dumps, impoundments, burial pits, USTs, and spill sites). The document identified high risk areas and evaluated the groundwater monitoring program, including the monitoring network, well integrity, and collection and sampling procedures.

- The *Geohydrologic Study No. 38-26-0920-87, Fort Benjamin Harrison, Indiana*, was completed by AEHA in May 1987 (AEHA, 1987). This report summarizes the installation and sampling of monitoring wells (one well as a background water quality monitoring point for the active landfill and five in the vicinity of the USTs at Building No. 4). As a result of the study, this report recommended monitoring groundwater around the current landfill and at two points along Lawrence Creek on a quarterly basis for one year for hazardous constituents and indicator parameters to assess the impact of the landfill on the groundwater regime.

- In 1987, AEHA compiled information on 15 SWMUs (AEHA, 1988). USAEHA concluded that eight of the identified SWMUs showed evidence of release to the environment or potential for release. The report listed proposed environmental sampling and/or action for these eight SWMUs plus an additional SWMU.

- The *Fort Benjamin Harrison Land Use Plan, Final Submittal*, was conducted by Buchart-Horn, Inc., for the Army, COE, Louisville District in February 1990 (Buchart-Horn, Inc., 1990). The purpose of the plan was to establish a complete definition of FBH land use, past and present, and to investigate how the installation interfaces with the surrounding community. In addition, the plan discusses current and long-range projects along with possible constraints to that development.

- The *Geohydrologic Study No. 38-26-K847-90, RCRA Facility Assessment - Sampling Visit, U.S. Army Soldier Support Center and Fort Benjamin Harrison, Fort Benjamin Harrison, Indiana, 2-13 April 1990* was published by AEHA in July 1990 (AEHA, 1990). The purpose of this study was to identify the presence of any release of hazardous constituents from the former coal storage yard adjacent to Building 2, the former landfill east of Lee Road and north of Hawley Army Hospital, and the former sewage treatment plant/fire training area at Building 810. Groundwater monitoring wells were installed in these areas, and groundwater samples were analyzed for metals (coal storage yard); VOCs, target compound list (TCL) base-neutral and acid extractable compounds (BNAs), pesticides, herbicides, PCBs, sulfates, nitrates, chlorides, and TDS (former landfill); and metals (including lithium), fuels, TCL BNAs, and VOCs, (former sewage treatment plant). The study concluded that these areas did not appear to have significantly affected the surrounding areas. Well MW20, near the former landfill, had the most significant levels of contamination, including vinyl chloride at a concentration greater than the drinking water standard. However, detection limits for VOCs were higher than the maximum contaminant level for some VOCs.

- The *Fort Sheridan, Illinois, Final Environmental Impact Statement* was prepared by the COE, Louisville District in October 1990 (COE, 1990). This document evaluate the withdrawal from the closure of the Fort Sheridan, Illinois, installation and the relocation of major units to Fort Benjamin Harrison, Indiana. The EIS was prepared to identify the effects of the planned action on the natural, social, and cultural environment not only at Fort Sheridan, but also at the receiving installations (i.e., FBH). No significant impact was expected as the result of the realignment action.

- A follow-up memorandum concerning the investigation at the former landfill was issued by AEHA to FBH on 28 January 1991 (AEHA, 1991). This memorandum concerned additional sampling of MW20, installation and sampling of a new monitoring well, and sampling of two surface-water points. The presence of vinyl chloride in MW20 was confirmed.

- The *Construction Clearance Study-Phase II, Monitoring Well Installation, Learning Resource Center, Fort Benjamin Harrison, Indiana*, was prepared by ERC Environmental and Energy Services Company (ERC) for the COE, Nashville District in June 1991 (ERC, 1991). The purpose of the study (and the Phase I that preceded it) was to determine the effects of the past use on site soils and groundwater using soil borings and monitoring wells. The study indicated the presence of contaminant concentrations of several constituents above regulatory action limits and the presence of others (i.e., total petroleum hydrocarbons [TPH]) for which there are no guidelines. Further investigation and monitoring well installation were recommended.

- Quarterly sampling results for select monitoring wells and surface-water sampling locations from October 1990 to August 1991 indicate little influence of the two landfills on ground-

water quality on the FBH installation. Detectable VOC concentrations were noted at certain wells immediately downgradient from the eastern landfill, as indicated by the periodic sampling events. In particular, the presence of vinyl chloride concentration exceeding the MCL was confirmed for Well MW20.

- The Enhanced PA for FBH was prepared by Roy F. Weston, Inc., for USATHAMA in February 1992 (Weston, 1992). The objectives of the Enhanced PA were to:

  - Identify and characterize AREEs associated with historical and current uses of the property.

  - Complete the Site Inspection (SI) Phase II Documentation Checklist for the AREEs identified.

  - Identify and characterize possible impacts of the AREEs on the surrounding environment.

  - Identify additional environmental actions, if any, that should be initiated for the AREEs identified.

  Information contained in the Enhanced PA report was obtained through:

  - Visual inspection of the facilities

  - Review of available Army information

  - Review of EPA Region V files

  - Review of IDEM files

  - Interviews with current employees familiar with FBH operations

  - Evaluation of aerial photographs

Table 2.1: Sensitive Plant and Animal Species Known to Occur or Potentially Occur at Fort Benjamin Harrison

	Status						Presence at FBH	
	F/E	F/CAT 2	S/E	S/T	S/SSC	S/WL	Verified	Potential
Plants								
Wood's sedge (*Carex woodii*)						x	x[a]	
Pink turtlehead (*Chelone oblique* var. *speciosa*)						x	x[a]	
Goldenseal (*Hydrastis canadensis*)						x	x[a]	
Ginseng (*Panax quinquefolius*)						x	x[a]	
Heart-leaved plantain (*Plantago cordata*)						x		x[b]
Bog bluegrass (*Poa paludigena*)		x						x[b]
Gyandotte beauty (*Synandra hispidula*)						x		x[b]
Running buffalo clover (*Trifolium stoloniferum*)	x		x					x[b]
Animals								
Mammals								
Indiana bat (*Myotis sodalis*)	x		x				x[b]	
Birds								
Great blue heron (*Ardea herodias*)					x[c]		x[b,d]	
Red-shouldered hawk (*Buteo lineatus*)					x		x[b,d]	
Broad-winged hawk (*B. platypterus*)					x		x[b,d]	
Northern harrier (*Circus cyaneus*)			x				x[b,e]	
Upland sandpiper (*Bartramia longicauda*)			x				x[b,e]	
Black tern (*Childonias niger*)			x				x[b,e]	
Golden-winged warbler (*Vermivora chrysoptera*)			x				x[b,e]	
Sharp-shinned hawk (*Accipiter striatus*)					x		x[b,e]	
Cooper's hawk (*A. cooperii*)					x[f]		x[b,e]	
Hooded warbler (*Wilsonia citrina*)					x		x[b,d]	
Black-and-white warbler (*Mniotilta varia*)					x		x[b,e]	
Worm-eating warbler (*Helmitheros vermivorus*)					x		x[b,e]	
Brown creeper (*Certhia americana*)					x[f]		x[d]	
Reptiles								
Kirtland's snake (*Clonophis kirtlandii*)		x		x				x[b]

Table 2.1 (continued)

	Status						Presence at FBH	
	F/E	F/CAT 2	S/E	S/T	S/SSC	S/WL	Verified	Potential
Fish								
Eastern sand darter (*Etheostoma pellucidum*)		x			x			x[b]

FBH Fort Benjamin Harrison
F/E Federal endangered
F/CAT 2 Federal Category 2 (species for which there is some evidence of vulnerability but for which insufficient data are available to support listing as threatened or endangered)
S/E State endangered
S/SSC State species of special concern (between 11 and 20 known occurrences statewide)
S/T State threatened
S/WL State watch list (vulnerable, but greater than 20 known occurrences statewide)

a. (Hedge, C.L., Bacone, J.A., and Baker, C., 1992)
b. (U.S. Fish and Wildlife Service, 1992)
c. Nests only
d. (Jackson, B.K., 1992)
e. Observed in 1984 as migrant or during foraging activity (U.S. Fish and Wildlife Service, 1992)
f. Removed from state species of special concern list

Table 2.2 Summary of Archeological Sites Identified at Fort Benjamin Harrison

Site No.	Description	Type	Approximate Period Dates
12MA249	World War I Entrenchment	WWI	1917 to 1918
12MA288	Blunt Homestead	Ag	1889 to 1904
12MA289	World War I Dump	WWI	1889 to 1913
12MA290	World War I Dump	WWI	1890 to 1920
12MA291	John M. Reddick Homestead	Ag	1889 to 1919
12MA292	Unknown Homestead	Ag	1900
12MA293	Reddick/Harper Homestead	Ag	1866 to 1911
12MA294	WWII Military Foundations	WWII	1946
12MA295	Dump	Ag	1900
	World War II Military Dump	WWII	1946 to 1947
12MA296	Fountain Kimberlain Homestead	Ag	1833 to 1941
12MA297	Historic Scatter	Ag	1900 to 1916
12MA298	F.M. Kimberlain Homestead	Ag	1866 to 1945
	World War II Dump	WWII	
12MA299	Prehistoric Scatter	Preh	Unknown
	Historic Scatter	Ag	1904+
12MA300	Prehistoric Scatter	Preh	Unknown
12MA301	Lord Hall Area (Military Dump)	WWII	1947
12MA302	World War I Entrenchments	WWI	1917 to 1918
12MA303	Stiers/Louden Homestead	Ag	1866 to 1889
12MA304	Historic Isolated Find	Ag	1900
12MA305	Speece Homestead	Ag	1828 to 1922
12MA306	Prehistoric Campsite	Preh	Unknown
	Spencer (?) Homestead	Ag	1828 to 1907
12MA307	Prehistoric Campsite	Preh	Unknown
	Military Dump	WWII	1930 to 1950
12MA308	Bates/Sproule Homestead	Ag	1866 to 1928
12MA311	William H. Baker (?) Homestead	Ag	1889 to 1907
12MA312	Prehistoric Scatter	Preh	Unknown
12MA313	Mrs. J. McHibben (?) Homestead	Ag	1866 to 1907
12MA314	Reddick Homestead	Ag	1889 to 1907
12MA315	Reddick/Baker Homestead	Ag	1866 to 1889
12MA316	Johnson/Baker Homestead	Ag	1907
12MA317	Johnson/Baker Homestead	Ag	1866 to 1907
12MA318	Military Historic Scatter	WWI	1908+
12MA319	Military Dump	WWI	1908+
12MA320	Military Dump	WWII	1933+
12MA321	Prehistoric Scatter	Preh	Unknown
12MA322	Hezekiah Smart Homestead	Ag	1889+
12MA379	Prehistoric Camp	Preh	3700 to 2000 B.C.
12MA380	Prehistoric Scatter	Preh	Unknown
12MA381	Prehistoric Scatter	Preh	Unknown
12MA382	Isolated Find	Preh	3700 to 3000 B.C.
12MA383	Geo. B. Yandes (?) Farmstead	Ag	1889 to 1907

Table 2.2 (continued)

Site No.	Description	Type	Approximate Period Dates
12MA384	Wm. Apple/H.D. Wheeler Farmstead	Ag	1889 to 1907

Ag Historical agricultural
Preh Prehistoric
WWI World War I
WWII World War II

Table 2.3: Disposition of Areas Requiring Environmental Evaluation (AREEs) Identified in Enhanced Preliminary Assessment (PA) at Fort Benjamin Harrison

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
Facility Operations			
1	DPCA Field Printing Shop (Bldg. 1)	Remove all printing and cleaning chemicals and solvents. Clean all exposed surfaces.	Inspected by Army and HLA during initial site visit. Draft Final TSP (HLA, 1992) recommended no investigative sampling. Before release of building, chemicals should be removed and exposed surfaces cleaned.
2	TASO Devices Shop (Bldgs. 479, 481)	Remove all printing and cleaning chemicals, solvents, and paints. Clean all exposed surfaces.	None. Enhanced PA indicated no known or suspected releases have been reported. Operations are conducted inside building and are fully contained.
3	Graphics Shop (Bldg. 1)	Remove all printing and cleaning chemicals and acetone. Clean all exposed surfaces.	Inspected by Army and HLA during initial site visit. Draft Final TSP (HLA, 1992) recommended no investigative sampling. Before release of building, chemicals should be removed and exposed surfaces cleaned.
4	Photographic Processing (Bldgs. 1, 300, 400, 434, 470, 479)	Remove all photographic processing solutions and wastes and silver recovery units. Clean all exposed surfaces. Wipe and chip sample surfaces for metals if buildings are to be excessed (post-remediation activity).	The Army and HLA inspected five photographic processing areas in Bldgs. 1, 300, 470, and 479 during initial site visit. Draft Final TSP (HLA, 1992) recommended no investigative sampling. Before release of buildings containing photographic processing areas, chemicals should be removed and exposed surfaces cleaned.
5	Weapons Cleaning Area (Bldg. 613)	None (potential contaminants in form of air emissions).	None. No potential for release outside of building identified in Enhanced PA.
6	Carpentry Shop (Bldg. 1)	Remove all paints, paint thinner, and solvents. Clean all exposed surfaces.	None. Except for floor drain, no potential for release outside of building identified in Enhanced PA.
7	Maintenance Shops		
	Electrical Shop (Bldg. 4)	See AREE 17.	Inspected by Army and HLA during initial site visit. Draft Final TSP recommended no investigative sampling for this AREE.
	Four Vehicle Maintenance Shops (Includes Roads and Grounds Shop) (Bldgs. 33, 127, 422, 705)	Remove all waste oils and other petroleum products. Clean all exposed surfaces, including concrete floors, that show any staining or other signs of spills. Install four to six soil borings (sample 0 to 6 inches and 1 to 2 feet) around fill valve and other areas near waste oil tank at auto craft shop.	Army and Air Force Exchange Services (AAFES) Gas Station, Bldg. 33 inspected by Army and HLA during initial site visit. Draft Final TSP recommended no investigative sampling. Before release of buildings, all solvent, POLs, and other chemicals should be removed and exposed surfaces cleaned.

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
			123rd Army Rescue Command Maintenance Shop Bldg. 127 included in RFI investigations (SWMU #2).
			Roads and Grounds Vehicle Maintenance Shop, Bldg. 422, included in EI investigations (EI Site 2).
			Auto Craft Shop, Bldg. 705, included in EI investigations (EI Site 1).
	Office Equipment Repair Shop (Bldg. 424)	See above.	Inspected by Army and HLA during initial site visit. Draft Final TSP recommended no investigative sampling. Before release of maintenance buildings, all solvent, POL, and other chemicals should be removed and exposed surfaces cleaned.
	Plumbing Shop (Bldg. 604)		Inspected by Army and HLA during initial site visit. Draft Final TSP recommended no investigative sampling. Before release of maintenance buildings, all solvent, POL, and other chemicals should be removed and exposed surfaces cleaned.
8	Former Maintenance Shops (Bldgs. 13, 36, 38, 109, 116, 424, 425, 426, 619)	Clean all surfaces including concrete floors if there is staining. Install one to two borings (sample 0 to 6 inches and 2 to 3 feet) adjacent to Bldgs. 619, 13, and 38 and former location of Bldg. 109.	Former Gas Station/Oil House, Bldg. 6 (identified as Bldg. 13) inspected by Army and HLA during initial site visit, which indicated that the most likely source for significant release is associated with the former USTs. USTs are addressed under other U.S. Army Corps of Engineers environmental programs.
8	Former Maintenance Shops (continued)	See above	Former DIS Transportation Motor Pool, Bldg. 36; Former Paint Shop, Bldg. 38; Former Vehicle Maintenance Shop, Bldg. 424; Former Vehicle Maintenance Shop, Bldg. 425; and Former Vehicle Maintenance Shop, Bldg. 426. The Army and HLA inspected Bldgs. 36, 38 and 424 during the initial site visit. (Bldgs. 425 and 426 were closed at the time of the site visit.) Based on the site visit and the Enhanced PA, no investigations were recommended in the Draft Final TSP. Before release of Former Maintenance Bldgs. 36 and 424, all solvent, POL, and other chemicals should be removed and exposed surfaces cleaned.
			Former 36th Engineers Maintenance Shop, Bldgs. 109 and 116, is located within the portion of FBH excluded from base closure and as a result is not included in RFI/EI activities. This area is addressed under other U.S. Army environmental programs.

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
			Former Post Exchange (PX) Gas Station, Bldg. 619. Inspected by Army and HLA during initial site visit. Except for releases from former USTs, the site is included in EI investigations (EI Site 3). USTs are addressed under other U.S. Army Corps of Engineers environmental programs.
9	Wash Racks, Grease Racks, and Oil/Water Separators (Bldgs. 4, 36, 116, 127, 422-426, 500, 515, 705)	Inspect all oil/water separators to ensure proper operation without any leaks. Conduct tests/inspections to verify/determine outlet locations. Advance soil borings at and/or downslope of all oil/water separators, wash racks, and grease racks (sample 0 to 6 inches and 2 to 3 feet). One to two sediment samples if oil/water separators drain/drained to ditch/storm sewer.	Wash racks, grease racks, and oil/water separators are included in the RFI Investigations (SWMU #FBH28).
10	POL Drum Accumulation Areas/POL Waste Staging (Bldgs. 34, 36, 109, 116, 127, 422, 424, and 705)	Clean all surfaces including concrete floors. Install one to two soil borings (sample 0 to 6 inches and 2 to 3 feet) at outdoor and former outdoor storage locations (Bldgs. 127 and 422).	No investigative sampling proposed at Bldgs. 34 and 36. Former 36th Engineers Maintenance Shop, Bldgs. 109 and 116, is located within the portion of FBH excluded from base closure and as a result is not included in RFI/EI activities. This area is addressed under other U.S. Army environmental programs. 123rd Army Reserve Command Maintenance Shop, Bldg. 127, included in RFI (SWMU #2). Roads and Grounds Maintenance Shop, Bldg. 422 included in EI investigations (EI Site 2). Auto Craft Shop, Bldg. 705, included in EI (EI Site 1).
11	Fueling Stations (Bldgs. 33, 239)	Clean concrete and asphalt cover in the vicinity of all gasoline dispensers if heavily stained. See AREE 21.	None, based on Enhanced PA recommendation.
12	DIS Engineering/Maintenance Bldg. Bldg. 26 Bldg. 108 (former location)	Clean all surfaces including concrete floors if there is staining. Collect destructive samples of the concrete floor in the northwest corner of Bldg. 26. Install one to two soil borings outside each building (sample 0 to 6 inches and 2 to 3 feet).	DIS, Engineering/Maintenance, Bldg. 26, included in EI (EI Site 4). Former DIS Engineering/Maintenance, Bldg 108, is located within the portion of FBH excluded from base closure and as a result is not included in RFI/EI activities. The area is addressed under other U.S. Army environmental programs.

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
Water Treatment Operations			
13	Water Treatment Laboratory/Plant Laboratory (Bldg. 604) Heating Plant (Bldg. 2)	Remove all laboratory and water treatment chemicals and reagents. Clean all exposed surfaces. Containerize spent reagents in laboratory-grade waste drums for disposal.	None, based on Enhanced PA recommendations.
Training Areas			
14	Training Areas/Ranges		
	Indoor Pistol Range (Bldg. 802)	None at indoor range.	Draft Final Work Plan (HLA, 1992) recommended no investigative sampling at indoor Pistol Range, Bldg. 802, based on Enhanced PA recommendations.
	Foreman Rifle Range (Bldg. 811, 812)	Conduct sediment and surface-water sampling in Schoen Creek Tributary to Lawrence Creek and in Lawrence Creek downstream and upstream of Foreman and State Police ranges.	Foreman Rifle Range, Bldgs. 811 and 812, included in RFI (SWMU #FBH22).
	State Police Pistol Range (Bldg. 815)		State Police Pistol Range, Bldg. 815, included in RFI (SWMU #FBH23).
	Skeet/Rifle Range (Bldgs. 819-822)	Install two to four soil borings at each outdoor firing range area (sample 0 to 6 inches and 2 to 3 feet). Install and sample monitoring wells based on results of soil borings.	Skeet/Rifle Ranges, Bldgs. 819-822, included in RFI (SWMU #FBH24).
	Troop training areas including north troop training area.	Survey north troop training area and install two to four soil borings at locations where POL products were used (sample 0 to 6 inches and 2 to 3 feet). Conduct further site reconnaissance for troop training areas to assess whether further recommendations for sampling are to be made.	North troop training areas inspected by Army and HLA during initial site visit. The areas are not included in the RFI/EI activities. These areas are addressed under other U.S. Army environmental programs.
Hazardous Materials Storage and Waste Handling Areas			
15	Former Drum Storage Area (So. of Bldgs. 45 and 46)	Sample existing wells. Install and sample three to four additional monitoring wells. Install two to four soil borings to depth of water table.	Former Drum Storage Area south of Bldgs. 45 and 46, included in RFI (SWMU #FBH8).

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
16	DRMO Hazardous Waste Storage Area (Bldgs. 124, 125 and outdoor area between buildings)	Install a total of two to four soil borings at and downslope of outdoor storage area (sample from 0 to 6 inches and 2 to 3 feet). Install and sample three to four monitoring wells. No recommendations for Bldg. 124. Bldg. 125 is under Part B permit; facility Closure Plan should, therefore, be implemented prior to excess.	DRMO Hazardous Waste Storage Area Bldgs. 124 and 125, is located within the portion of FBH excluded from base closure and addressed under other U.S. Army environmental programs.
17	PCB-containing Waste Storage Areas (Adjacent to Bldgs. 4, 46, 110, 124, and 125)	Two to four surface soil samples (sample from 0 to 6 inches at each area).	Electrical Shop, Bldg. 4, included in EI (EI Site 5). PCB-containing Waste Storage Area, Bldg. 46, is included in the Former Drum Storage investigation area (SWMU #FBH8). PCB-containing Waste Storage Areas, Bldgs. 110, 124, and 125 located within the portion of FBH excluded from base closure and addressed under other U.S. Army environmental programs.
18	Pesticide Mixing and Storage Areas		
	DIS Former Storage (Bldg. 27)	Install two soil borings in downslope direction (sample from 0 to 6 inches and 2 to 3 feet). Wipe and/or chip samples of building surfaces.	DIS Former Pesticide Storage, Bldg. 27, included in RFI (SWMU #FBH18).
	DRMO (Bldg. 125)	See AREE 16.	See AREE 16.
	Former Storage (Bldg. 514)	Two surface soil samples (sample from 0 to 6 inches). Wipe and/or chip samples of building surfaces.	Former Pesticide Storage, Bldg. 514, included in RFI (SWMU #FBH19).
	DIS Storage and Mixing (Bldg. 605)	Two to four soil borings (sample 0 to 6 inches and 2 to 3 feet). Two to four sediment samples in drainageway and in Hawthorne Lake; include background sample (sample 0 to 6 inches and 1 to 2 ft where possible). Wipe and/or chip samples of building surfaces.	Former DIS Pesticide Storage and Mixing Area, Bldgs. 604 and 605, included in RFI (SWMU #FBH20).
	Golf course (Bldg. 674)	Two surface soil samples (sample 0 to 6 inches). Wipe and/or chip samples of building surfaces.	Golf Course Pesticide Storage, Bldg. 674, included in RFI (SWMU #FBH21).

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
19	Buried Lithium Bromide Drums (Adj. to Bldg. 810)	First conduct geophysical survey using GPR to locate drums. Based on results of survey, excavate area and remove drums. Following removal of drums, collect one to two composite soil sample(s) at excavated area. See AREE No. 20 for monitoring well recommendations.	Investigation of buried lithium drums included in RFI (SWMU #FBH11). See AREE No. 20.
Sanitary Wastewater Treatment Plants			
20	Former Sewage Treatment Plants		
	Current Fire Training Area (Bldg. 810)	Four surface soil samples (sample 0 to 6 inches) from former sludge drying beds and one sediment sample (sample 0 to 6 inches) downstream of former outfall. Install two soil borings to water table in former treatment tank areas. Determine integrity of existing wells; sample existing wells and install two to four additional monitoring wells up- and downgradient of STP (based on integrity sampling of existing wells).	Former Sewage Treatment Plant, Bldg. 810, included in RFI (SWMU #FBH11).
	Historic maps/south of Shafter Road (west of Bldg. 674)	Use geophysical survey, if necessary, to locate boundaries of former treatment beds off Shafter Road. Install two to four soil borings (sample 0 to 6 inches and 2 to 3 feet).	Former Sewage Treatment Plant, near Bldg. 674, included in RFI (SWMU #FBH26).
	Historic files/east area of installation	Conduct further site reconnaissance to locate former east sewage plant. If location is found, use geophysical survey (if necessary) to locate boundaries and install two to four soil borings (sample at 0 to 6 inches and 2 to 3 feet).	Former Sewage Treatment Plant, near Bldg. 509, included in RFI (SWMU #FBH27).

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
Storage Tanks			
21	Underground Storage Tanks	Continue current installation program, which includes removal of tanks as scheduled, leak-testing of tanks periodically, removal of any leaking tanks or tanks taken out of service, and verification sampling of soil following tank removal. Continue current followup program for leaking tanks (LUST program).	USTs are addressed under other U.S. Army environmental programs. See CERFA Report (Arthur D. Little, Inc., 1993).
22	Aboveground Storage Tanks	Install two or four soil borings (sample from 0 to 6 inches and 2 to 3 feet) near fill valves/points and in additional areas near ASTs without concrete berms/secondary containment. Additional sampling may be required in stained areas.	ASTs are addressed under other U.S. Army environmental programs.
Landfills and Incinerators			
23	Former Sanitary Landfill (east) (NW of Bldg. 304)	Sample seepage (leachate) and resample surface water at southern extreme of landfill. Determine integrity of existing wells and then sample all wells where appropriate. Install and sample new wells, if necessary, east and north of landfill. Coordinate sampling program with City of Lawrence due to deed status of land.	The east landfill is located in an area deeded to the City of Lawrence. Possible surface-water and groundwater effects evaluated under RFI background sampling program.
24	Former Sanitary Landfill (west) (West of Bldgs. 800-809)	Determine integrity of existing monitoring wells and then sample. Install and sample new wells if necessary. Sample seepage at the north end of landfills.	Landfills are addressed under other U.S. Army Corps of Engineers environmental programs.
25	Former Incinerators		
	Hospital (Bldg. 300)	None for former hospital incinerator. See AREEs 23 and 24 for recommendations for landfills.	None, based on recommendations in Enhanced PA.
	Sanitary Waste Incinerator (Bldg. 518)	Conduct geophysical survey using GPR to determine if ash or other wastes have been disposed of adjacent to incinerator building and extent of disposal area. Two to four test pits, depending on results of geophysical survey.	Sanitary Waste Incinerator, Bldg. 518, included in RFI (SWMU #FBH17).

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
Medical Facilities			
26	Hospital and Clinics	Remove all hazardous constituents and infectious wastes prior to excessing property. See AREEs 4 and 25 for photographic processing areas and former incinerator.	None, based on recommendations in Enhanced PA.
	Occupational Health Clinic (Bldg. 1)		
	Hawley Army Hospital (Bldg. 300)		
	Dental Clinic (Bldg. 300)		
Burn Pit Areas			
27	Fire Training Area		
	Training Pit Area (Adj. to Bldg. 810)	See recommendations for Former Sewage Treatment Plant, AREE 20.	Training Pit Area (Adj. to Bldg. 810) included with RFI Former Sewage Treatment Plant, Bldg 810 (SWMU #FBH11).
	Former Training Areas (North of Bldg. 518, east of west landfill)	Confine all fire training activities to training pit area. No further recommendations for former training areas.	None, based on recommendations in Enhanced PA.
Spill Areas and Other Releases			
28	Spill Areas		
	PCB Spill Areas	Four to six sediment samples in creeks/ponds/lakes (sample 0 to 6 inches) at locations throughout the installation. Collect samples for TPH analysis from the waterline areas. Further investigate supposed offpost asphalt spill. No further recommendations for other spill areas.	Effects of spills addressed by RFI background surface-water and sediment sampling.
	Other Spills (see Subsection 3.11 for locations)		
Ammunition Storage			
29	Ammunition Storage Areas (Bldgs. 519-522)	Obtain access to buildings; remove all ammunition and boxes prior to excess. Consider disposal options for PCP in ammunition boxes. Two to four soil samples (sample 0 to 6 inches). Wipe and/or chip samples of building surfaces for building closure.	Inspected by Army and HLA during initial site visit. Draft Final TSP (HLA, 1992) recommended no investigative sampling. Before release of the buildings, all ammunition should be removed and exposed surfaces cleaned.

Table 2.3 (continued)

AREE No.	Description/Location	Activity Recommended in Enhanced PA	RFI/EI Activity
Coal Storage Yard			
30	Former Coal Storage Yard (NE of Bldg. 2)	Install two to four confirmatory soil borings (sample 0 to 6 inches and 2 to 3 feet) in locations not previously sampled. Two to four sediment samples in drainage pathways.	Former Coal Storage Yard, included in EI (EI Site 6).
Facilitywide AREEs			
31	Asbestos (Basewide)	Continue surveying buildings. Generate asbestos management and abatement plan. Remove or encapsulate known exposed friable asbestos.	Asbestos is addressed under other U.S. Army environmental programs. See CERFA report (Arthur D. Little, Inc., 1993).
32	Pesticide Usage (Basewide)	Four to six sediment samples in creeks/ponds/lakes (sample 0 to 6 inches) at locations throughout the installation.	Effects of pesticide usage are address by RFI background soil, groundwater, surface-water, and sediment sampling.
33	Former Coal Storage Areas (Basewide)	No further recommendations.	None, based on recommendations in Enhanced PA.
34	Radon (Basewide)	Continue screening program to include all buildings at the installation and implement appropriate remediation measures where necessary, based on results (if above EPA action level).	Radon is addressed under other U.S. Army Corps of Engineers environmental programs. See CERFA report (Arthur D. Little, Inc., 1993).
35	Boiler Blowdown (Basewide)	None (small potential for contamination due to concentration and types of chemicals used).	None, based on recommendations in Enhanced PA.
36	Transformers (Basewide)	No further recommendations.	None, based on recommendations in Enhanced PA. See CERFA Report (Arthur D. Little, Inc., 1993).

AREE	Area requiring environmental evaluation
AST	Aboveground storage tank
CERFA	Community Environmental Response Facilitation Act
DIS	Directorate of Installation Support
DRMO	Defense Reutilization and Marketing Office
EI	Environmental investigation
FBH	Fort Benjamin Harrison
EPA	U.S. Environmental Protection Agency
GPR	Ground penetrating radar

Table 2.3 (continued)

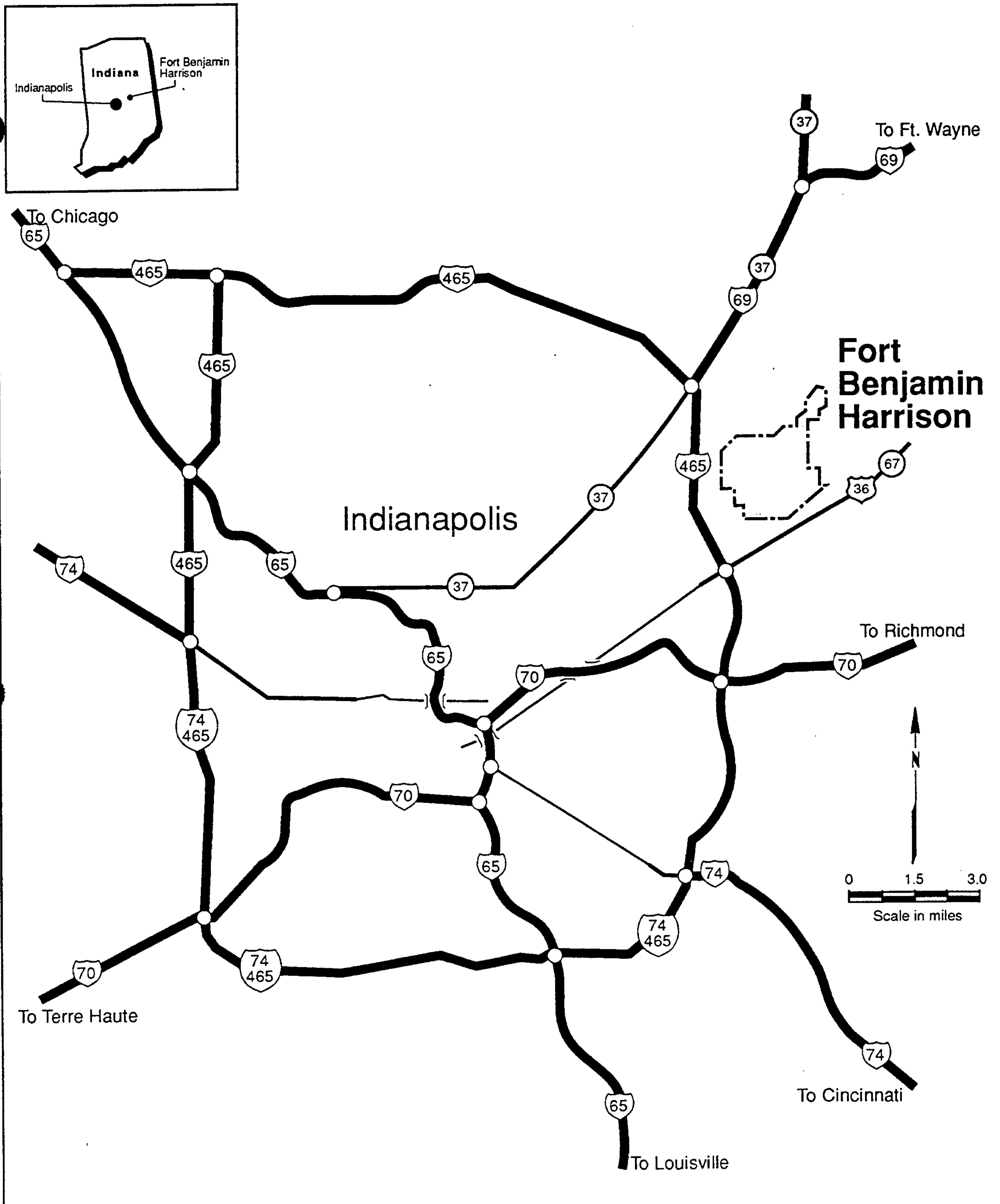
HLA	Harding Lawson Associates
LUST	Leaking underground storage tank
PA	Preliminary assessment
PCB	Polychlorinated biphenyl
POL	Petroleum, oils, and lubricants
RFI	Resource Conservation and Recovery Act Facility Investigation
SWMU	Solid waste management unit
TPH	Total petroleum hydrocarbons
TSP	Technical Sampling Plan
UST	Underground storage tank

Table 2.4: Sites Investigated During the Phase I Environmental Investigation

Environmental Investigation (EI) Sites

EI Site Number	Site Description
1	Auto Craft Shop, Building 705 (not including Used Oil UST)
3	Former PX Gas Station, Building 619
4	DIS Engineering/Maintenance, Building 26
5	Electrical Shop, Building 4
6	Former Coal Storage Yard, Building 2
SM18	DIS Maintenance Storage Shed, Building 27
SM19	Pesticide Mixing and Storage Area, Building 514
SM20	DIS Entomology, Building 605
SM21	Golf Course Mixing and Storage Area, Building 674
SM22	Foreman Firing Range, Buildings 811 and 812
SM23	State Police Pistol Range, Building 815
SM24	Skeet/Rifle Range, Buildings 819 through 822
SM25a-l	Historic Military Sites, basewide
SM26	Former Sewage Treatment Plant, west of Building 674
SM27	Former Sewage Treatment Plant, north of Building 509
SM28	Wash Racks/Grease Racks/Oil-Water Separators, basewide
SM29	Patriotic Site

DIS	Directorate of Installation Support
PX	Post exchange
UST	Underground storage tank



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Engineering and Environmental Services

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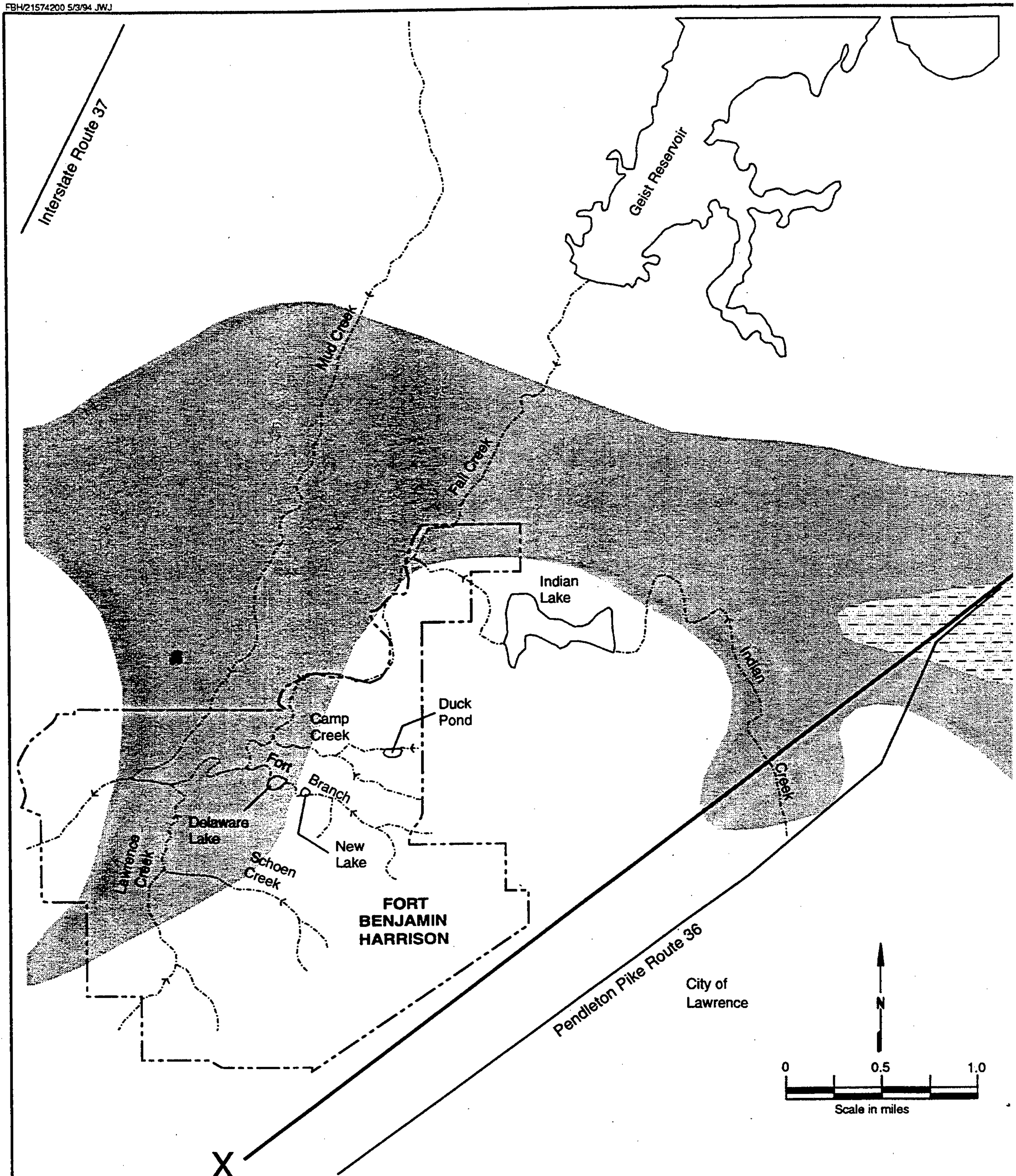
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Fort Benjamin Harrison
Marion County, Indiana

Figure 2.1
Site Location Map

FBH/21574200 5/3/94 JWJ



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HLA

Bedrock Geology and Cross Section Location Map

Source: Roy F. Weston, 1992

Explanation

Installation boundary

Surface drainage

X—X' Location of geologic cross section

NGVD National Geodetic Vertical Datum of 1929

Consolidated Units:

Dolomitic limestone of middle Devonian age

Limestone dolomite and shale of Silurian age

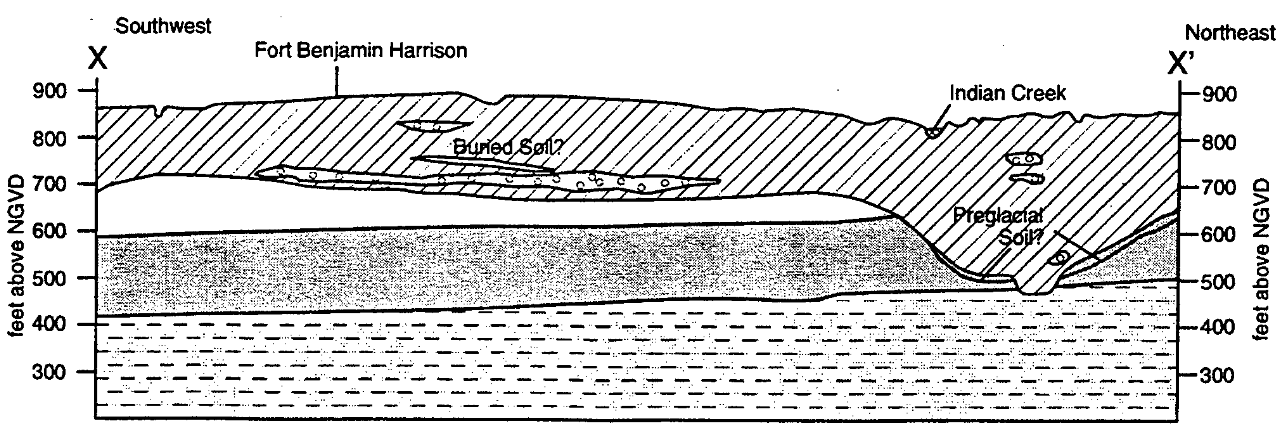
Shaly limestone of late Ordovician age

Unconsolidated quaternary deposits:

Alluvial sand, silt, and clay-
Recent stream deposits. Yellowish gray or gray; black where considerable organic material. Generally underlain by outwash sand and gravel.

Outwash sand and gravel-
Glacial stream deposits. Yellowish gray or light gray. Principally sand and sandy gravel, some silt and clay and scattered cobbles and boulders.

Till-
Glacial ice deposits. Yellowish gray, bluish gray, or gray. Principally sand or silt, some clay and pebbles and scattered cobbles and boulders.

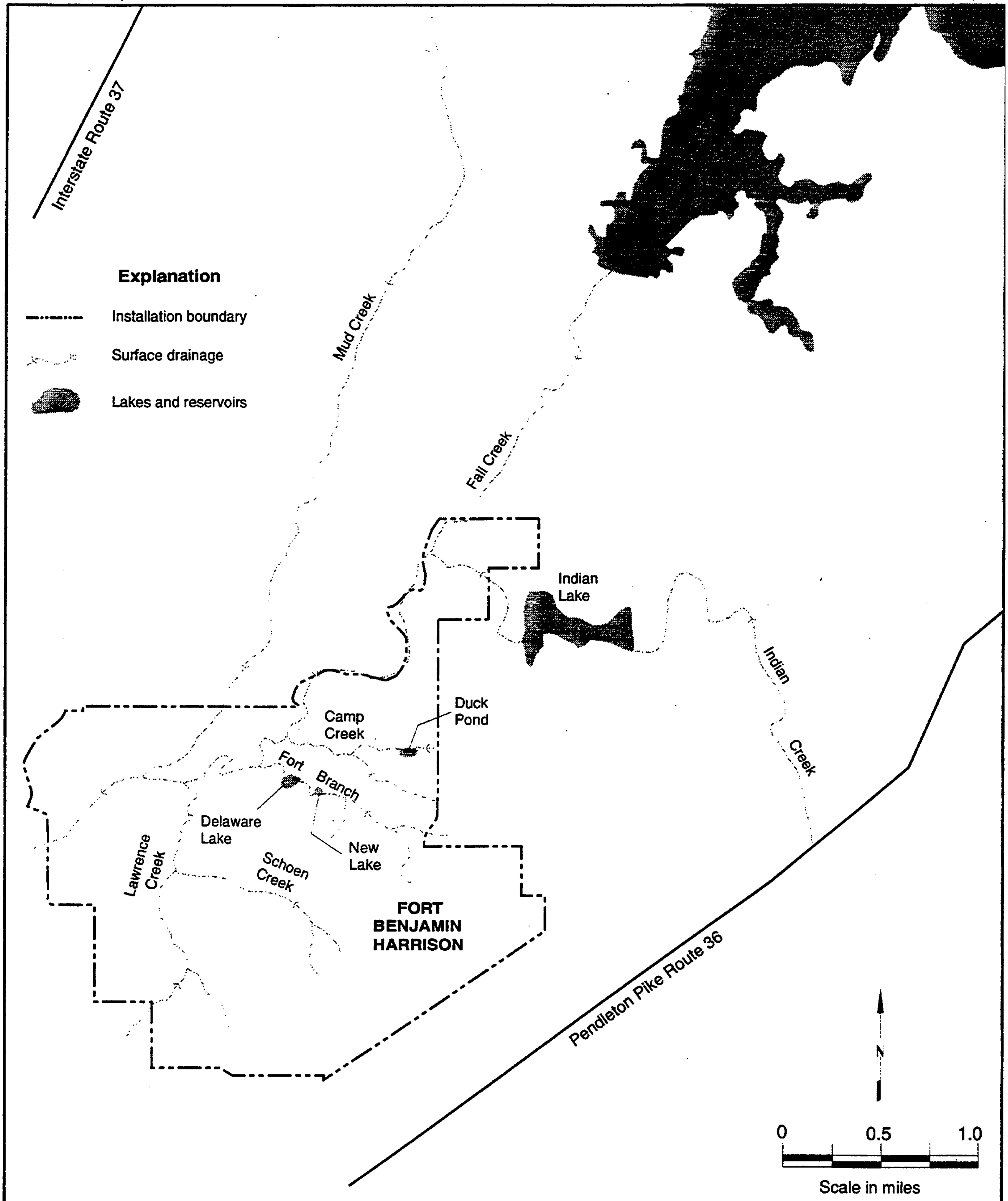


Source: Weston, 1992

Generalized Geologic Cross Section
Source: Roy F. Weston, 1992

Prepared for: U.S. Army Environmental Center Aberdeen Proving Ground, Maryland Fort Benjamin Harrison Marion County, Indiana	Figure 2.2 Bedrock Geologic Map and Generalized Geologic Cross Section of Fort Benjamin Harrison and Vicinity

FBH/FBHDRAIN 5/3/94 JWJ



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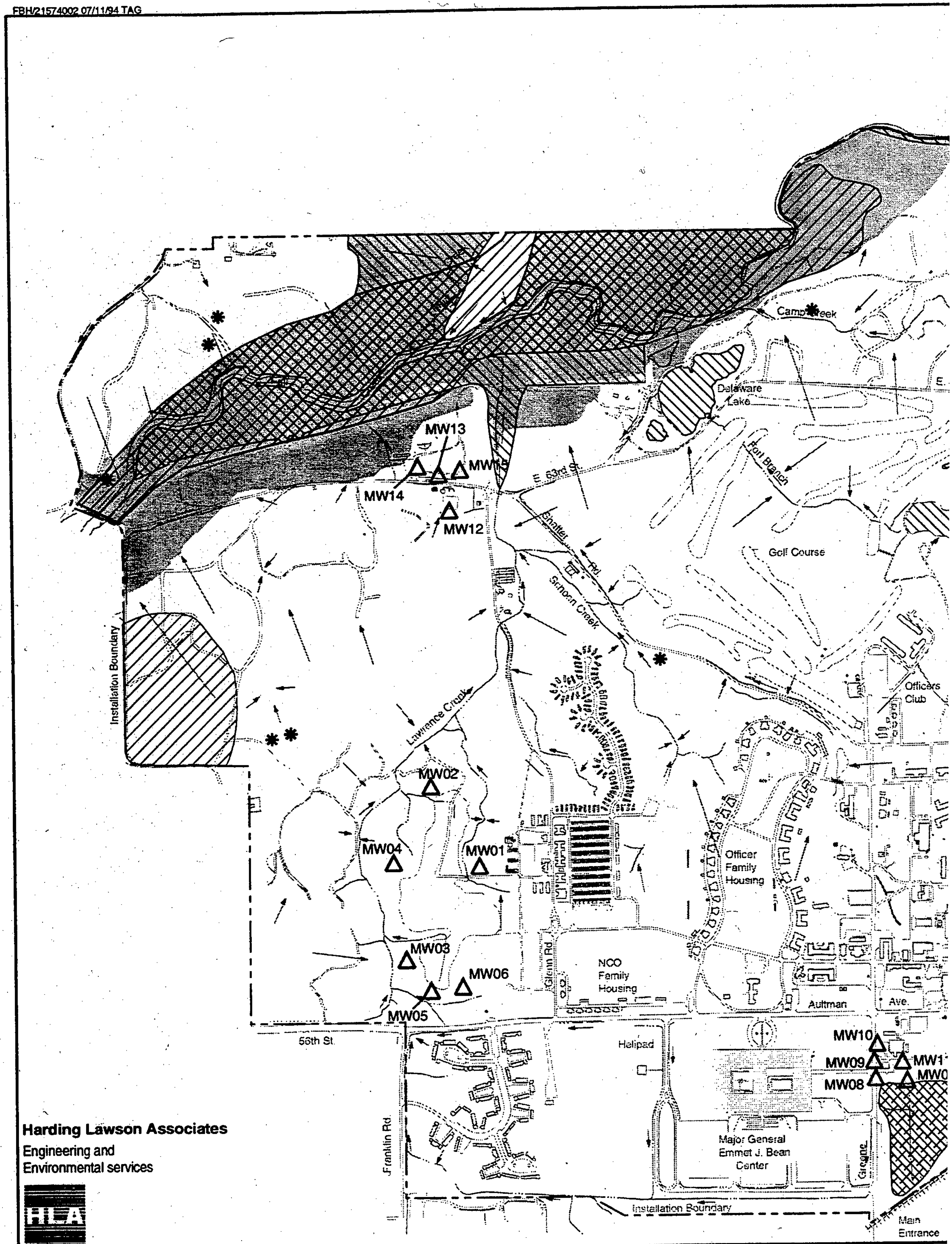
Aberdeen Proving Ground, Maryland

Fort Benjamin Harrison
Marion County, Indiana

Figure 2.3

General Surface Drainage Map of Fort Benjamin Harrison and Vicinity



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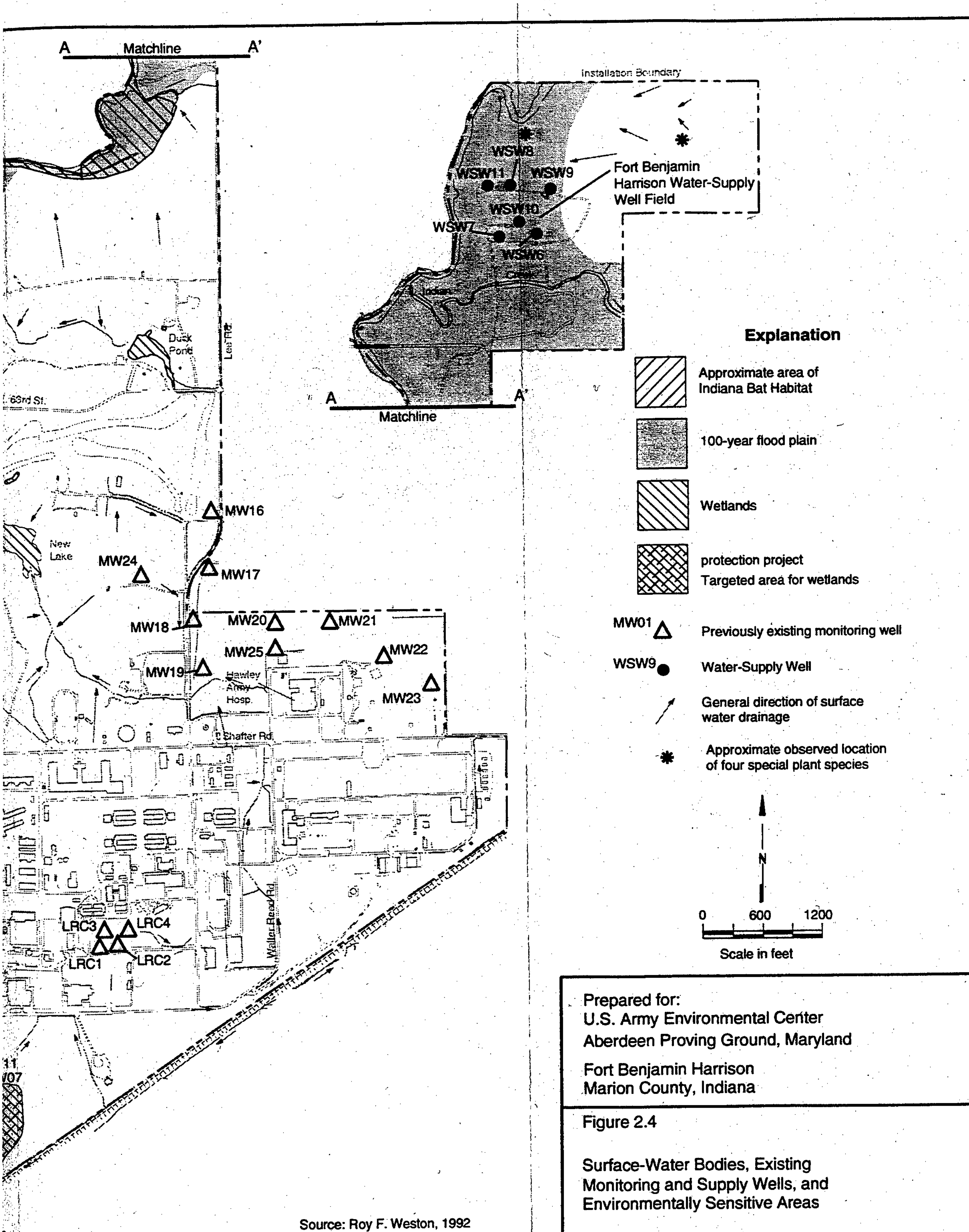

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U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Fort Benjamin Harrison
Marion County, Indiana

Figure 2.4

Surface-Water Bodies, Existing Monitoring and Supply Wells, and Environmentally Sensitive Areas

3.0 PHASE I ENVIRONMENTAL INVESTIGATION

The Phase I EI at FBH consisted of an investigation of 28 EI sites and the collection of background samples. The following sections present the technical approach of the EI, including (1) a summary of the investigation activities, (2) the background sampling locations and results, (3) the analytical program, (4) the EI evaluation process, (5) the basewide geology, and (6) the basewide hydrogeology.

3.1 Summary of Investigation Activities

The locations of the 28 EI sites identified for investigation are presented in Figure 3.1. These areas, with the exception of the Patriotic Site and the Historic Grenade Course, were previously identified as AREEs or historic military sites in the Enhanced PA performed at FBH (Weston, 1992). The Patriotic Site was identified for investigation by the Army, and the Historic Grenade Course was identified in the Draft CERFA report (Arthur D. Little, Inc., 1993).

The Phase I EI field sampling program consisted of the following major elements:

- Soil-gas surveys
- PCB screening (surface soil)
- Geophysical surveys
- Borehole and soil-gas sampling location clearance
- Surface soil sampling
- Soil borings and subsurface soil sampling
- Monitoring well installation and groundwater sampling
- Surface-water sampling
- Sediment sampling
- Land survey

Specific activities conducted at each site are listed in Table 3.1.

3.1.1 Soil-Gas Surveys

A reconnaissance soil-gas survey was performed to semiquantitatively measure the vapor-phase concentrations of total volatile hydrocarbons (TVH) and VOCs within the shallow soil in locations where; on the basis of historical use, solvents and petroleum-related products may have been disposed. The soil-gas investigative technique was used to investigate the following EI sites:

- Auto Craft Shop, Building 705 (EI Site 1)
- Former Post Exchange (PX) Gasoline Station, Building 619 (EI Site 3)
- Directorate of Installation Support (DIS) Engineering/Maintenance, Building 26 (EI Site 4)
- Historic Military Sites (EI Sites SM25c and SM25f)

The soil-gas sample collection procedures were conducted as described in Appendix A of the TSP (HLA, 1993a). Soil-gas target analytes and their respective detection limits are discussed in Section 3.3. Soil-gas results are discussed by EI site in Section 4.0 and are presented in Appendix A.

3.1.2 PCB Screening

HLA collected and analyzed surface soil samples onsite for PCBs using the EnSys PCB RISc® Soil Test System. The screening tests were conducted to evaluate surface soil in locations where, on the basis of historical use, PCBs may have been stored or used. The PCB screening investigative technique was used to investigate the following EI sites:

- DIS Engineering/Maintenance, Building 26 (EI Site 4)
- Electrical Shop, Building 4 (EI Site 5)

The PCB surface soil screening sample collection and analysis procedures were conducted as described in Appendix A of the TSP (HLA, 1993a). PCB screening results are discussed in Section 4.0 and are presented in Appendix B.

3.1.3 Geophysical Survey

Geophysical surveys were performed at seven FBH EI sites. The objectives of the surveys were to (1) locate possible buried materials such as drums, residual site substructures or metallic debris, or landfill areas, and (2) delineate areas of anomalous geophysical response indicative of additional subsurface disposal. The geophysical methods used for these surveys were electromagnetic (EM) profiling (M-Scope), ground penetrating radar (GPR), and a radio-frequency pipe and cable locator (RD-400). Geophysical data were obtained along transects spaced 20 feet apart in both north-south and east-west directions at all seven EI sites. Preliminary interpretations were made in the field, and all data were submitted to HLA's Novato, California, office for final analysis. At sites where other information was insufficient for underground utility clearance, geophysical methods were used to evaluate the presence or absence of underground utility lines and other obstructions to drilling. The surface geophysical techniques and the borehole clearance techniques are discussed in the following subsections.

3.1.3.1 Surface Geophysics

GPR and EM were used during the FBH investigation to investigate the following seven EI sites at FBH:

- Historic Military Sites (EI Sites SM25b, c, f, i, j)
- Former Sewage Treatment Plant, West of Building 674 (EI Site SM26)
- Former Sewage Treatment Plant, North of Building 509 (EI Site SM27)

The geophysical investigation procedures were conducted as described in Appendix A of the TSP (HLA, 1993a). The geophysical surveys for each of the seven EI sites are discussed in Section 4.0 and methods, equipment, and procedures are presented in Appendix K.

3.1.3.2 Borehole Clearance

The borehole clearance program was conducted before performing any intrusive activities (i.e., soil-gas sampling, drilling, or excavation work) to investigate the presence of buried metal debris, metal

drums, pipelines, or utility lines that could pose a safety risk during drilling or excavation activities. Two methods of detecting subsurface obstructions were used during the borehole clearance program. The M-Scope (an EM device with a short coil spacing) was used in areas where there was significant interference from surface metal. An RD-400 pipe and cable locator was used to identify buried energized cables. In all areas, a metal detector was used to clear for surface (0.0- to 2-feet deep) metal.

3.1.4 Surface Soil Sampling

Surface soil samples were collected for analysis from 14 EI sites, as summarized in Table 3.1, and 21 background sampling locations. The 21 surface soil background sampling locations are shown in Figure 3.2. Surface soil samples were collected from the following EI sites:

- DIS Engineering/Maintenance, Building 26 (EI Site 4)
- Electrical Shop, Building 4 (EI Site 5)
- Former Coal Storage Yard, Building 2 (EI Site 6)
- Pesticide Mixing and Storage Areas, Building 514 (EI Site SM19)
- Pesticide Mixing and Storage Areas, DIS Entomology Building 605 (EI Site SM20)
- Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, west of Building 674 (EI Site SM21)
- Firing Range, Foreman Rifle Range, near Buildings 811 and 812 (EI Site SM22)
- Firing Range, State Police Pistol Range, near Building 815 (EI Site SM23)
- Firing Range, Skeet/Rifle Range, near Buildings 819 through 822 (EI Site SM24)
- Historic Military Sites (EI Sites SM25b, SM25h, SM25i, SM25j, SM25k)

Each of the surface soil samples was collected from a depth of 0.0 to 0.5 foot. A total of 124 surface soil samples were collected during the Phase I EI. The analytical suites and number of samples analyzed are presented in Table 3.2. The analytical suites selected for surface soil samples at each EI were selected on the basis of current and historical use of the site. Surface soil sampling procedures

are discussed in detail in Appendix A of the TSP (HLA, 1993a). Surface soil sampling results are discussed by EI site in Section 4.0.

3.1.5 Soil Boring and Subsurface Soil Sampling

Subsurface soil samples were collected for analysis from 12 EI sites and 11 background sampling locations. Investigation activities conducted at the 12 EI sites are described in Table 3.1. The 11 subsurface soil background sampling locations (soil borings) are shown in Figure 3.2. Subsurface soil samples were collected from the following EI sites:

- Auto Craft Shop, Building 705 (EI Site 1)
- Former Post Exchange Gasoline Station, Building 619 (EI Site 3)
- DIS Engineering/Maintenance, Building 26 (EI Site 4)
- Electrical Shop, Building 4 (EI Site 5)
- Former Coal Storage Yard, Building 2 (EI Site 6)
- Pesticide Mixing and Storage Area, DIS Entomology Building 605 (EI Site SM20)
- Firing Range, Foreman Rifle Range, near Buildings 811 and 812 (EI Site SM22)
- Firing Range, State Police Pistol Range, near Building 815 (EI Site SM23)
- Firing Range, Skeet/Rifle Range, near Buildings 819 through 822 (EI Site SM24)
- Historic Military Sites (EI Sites SM25c and SM25f)
- Patriotic Site (EI Site SM29)

Each subsurface soil sample was collected from a discrete 6-inch interval of the borehole using either (1) a split-spoon sampler and stainless-steel liner or (2) a hand auger and wide-mouth glass sampling container. Borehole drilling and subsurface soil sampling procedures are discussed in Appendix A of the TSP (HLA, 1993a). A total of 109 subsurface soil samples were collected from the EI sites during the investigation of subsurface soil at FBH. A summary of the soil samples collected during the Phase I EI is presented in Table 3.1. Subsurface soil sampling results are discussed by EI sites in Section 4.0.

3.1.6 Monitoring Well Installation and Groundwater Sampling

Groundwater samples were collected for analysis from 3 EI sites and 17 background sampling locations. Groundwater samples were collected from the following EI sites:

- Auto Craft Shop, Building 705 (EI Site 1)
- Former Post Exchange Gasoline Station, Building 619 (EI Site 3)
- DIS Engineering/Maintenance,Building 26 (EI Site 4)

Investigative groundwater samples were collected from newly installed monitoring wells as shown in EI site-specific figures. Background groundwater sampling locations are shown in Figure 3.2. HLA evaluated the condition of existing monitoring wells before collecting any groundwater samples. Available information used to evaluate the existing wells is summarized in Table 3.3. Twelve wells were sampled during the EI. A summary of the groundwater samples collected during the EI is presented in Table 3.1. The analytical suites and number of samples analyzed are presented in Table 3.2. A summary of the monitoring wells sampled during the Phase I EI is presented in Table 3.4.

Monitoring well design was modified from that proposed in the TSP (HLA, 1993a) because of lithology and the shallow depth at which groundwater was first encountered during drilling. Because subsurface conditions varied from site to site, monitoring wells were constructed with 2.5-, 5.0-, or 10.0-foot lengths of 4-inch inside-diameter, slotted (0.010-inch) polyvinyl chloride (PVC) screen and blank casing. The boring logs indicate that fine-grained materials (i.e., silt and clay) are the predominant type of lithology at the investigation sites. During drilling, it was noted by the HLA geologists that the first occurrence of groundwater during drilling was typically associated with thin sand or silty sand lenses (some with gravel) and/or zones of fine-grained soil with a sand content somewhat greater than that encountered either above or below. Monitoring well screens were placed at specific depths within borings to target these water-bearing zones. Shorter well screen lengths were used for some wells where the boring had to be terminated to avoid drilling through a less

permeable material (i.e., greater than 3 feet thick). The depths at which the well screens were placed above the first groundwater encountered, the height of the sand pack above the top of the well screen, and the thickness of the bentonite pellet seal were also modified (decreased) from that proposed in the TSP (HLA, 1993a) because of shallow groundwater conditions encountered at FBH.

Well development and groundwater sampling procedures were modified from those proposed in the TSP (HLA, 1993a) because of the slow recharge rate experienced by most of the wells. As a result, wells that were dewatered before purging five purge volumes were allowed to recover for approximately four hours, or until the well had recovered to approximately 80 percent of the prepurge static level. If a well recovered to approximately 80 percent or more of the prepurge static level, the well was purged until it was dewatered. The well was then allowed to recover sufficiently prior to collecting a groundwater sample. If a well did not recover to approximately 80 percent of the prepurge static level within four hours, the well was not purged further, but was allowed to recover sufficiently to collect a groundwater sample. Groundwater sampling results are discussed by EI site in Section 4.0. Monitoring well installation procedures are provided in Appendix A of the TSP (HLA, 1993a).

3.1.7 Surface-Water Sampling

Surface-water samples were collected for analysis from four EI sites and 15 basewide sampling locations. Basewide surface-water sampling and results are discussed in Section 4.8 of the Phase I RFI Report (HLA, 1994b). The four EI sites investigated are as follows:

- Pesticide Mixing and Storage Area, DIS Maintenance Storage Shed, Building 27 (EI Site SM18)
- Pesticide Mixing and Storage Area, DIS Entomology Building 605 (EI Site SM20)
- Firing Range, Foreman Rifle Range, near Buildings 811 and 812 (EI Site SM22)
- Firing Range, State Police Pistol Range, near Building 815 (EI Site SM23)

Eight surface-water samples were collected during the Phase I EI at FBH. A summary of the surface-water samples collected during the Phase I EI is presented in Table 3.1. Stream flow dimensions and velocity were measured when surface-water samples were collected. These measurements were used to calculate flow (stream discharge) (Appendix I). The analytical suites and number of samples analyzed are presented in Table 3.2. Target analytes and their respective detection limits are discussed in Section 3.3. Surface-water sampling results are discussed by EI site in Section 4.0.

3.1.8 Sediment Sampling

Sediment samples were collected for analysis from five EI sites and 19 basewide sampling locations. Basewide sediment sampling and results are discussed in Section 4.8 of the Phase I RFI Report (HLA, 1994b). The five EI sites investigated are as follows:

- Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27 (EI Site SM18)
- Pesticide Mixing and Storage Areas, DIS Entomology Building 605 (EI Site SM20)
- Golf Course Pesticide Mixing Area, Building 674 (EI Site SM21)
- Firing Range, Foreman Rifle Range, near Buildings 811 and 812 (EI Site SM22)
- Firing Range, State Police Pistol Range, near Building 815 (EI Site SM23)

A total of 11 sediment samples were collected from the 5 EI sites during the Phase I EI at FBH. Sediment sampling procedures are discussed in Appendix A of the TSP (HLA, 1993a). A summary of the sediment samples collected during the Phase I EI is presented in Table 3.1. The analytical suites and number of samples analyzed are presented in Table 3.2. Target analytes and their respective detection limits are discussed in Section 3.3.2. Sediment sampling results are discussed by EI site in Section 4.0.

3.2 Background Sampling Performed

To assess the background concentrations for analytes in the various analytical suites and sample media at FBH, sampling was conducted in areas believed not to have been influenced by past site

activities. The following subsections discuss the background sampling locations and the number of analyses.

General background sampling included collecting surface soil, subsurface soil, and groundwater samples. Background sampling provided chemical data for each medium sampled.

The purpose of background sampling was to assess the ambient concentrations of target compounds in soil and groundwater that are not influenced by past site activities. Existing data indicated that shallow groundwater flow in the vicinity of the developed area at FBH is generally to the northwest toward Fall Creek; therefore, background subsurface soil and groundwater samples were generally collected along the upgradient southeast boundary of FBH (Figure 3.2).

The background sampling field investigation consisted of the following activities:

- Collection and analysis of 21 surface soil samples
- Collection and analysis of 49 subsurface soil samples from 11 soil borings
- Installation of 7 new monitoring wells; collection and analysis of 1 round of groundwater samples from the 7 new wells and 10 previously existing wells
- Land surveying of new and existing wells for Universal Transverse Mercator (UTM) coordinates, latitude and longitude, and elevations above NGVD

A summary of the sampling rationale and locations for background samples is provided in Table 3.5. Figure 3.2 identifies background sampling locations. A description of background sampling field investigation activities follows and is summarized in Table 3.6.

3.2.1 Background Surface Soil Samples

Twenty-one surface soil samples (SMBKGSS001 through SMBKGSS021) were collected to assess the ambient concentrations of target compounds in surface soil. Each of these samples was collected from a depth of 0.0 to 0.5 feet. Three background soil samples (SMBKGSS011 through

SMBKGSS013) were collected southwest of Building 1, and four samples (SMBKGSS014 through SMBKGSS017) were collected along the southeast and east boundaries of FBH within the Crosby-Brookston soil association. Three surface soil samples (SMBKGSS008 through SMBKGSS010) were collected west of the officer family housing area, and four samples (SMBKGSS018 through SMBKGSS021) were collected in the east-northeast portion of FBH within the Miami-Crosby soil association. Aerial photographs and historical site maps indicated that samples collected from these locations would be collected from undisturbed areas. Three soil samples (SMBKGSS005 through SMBKGSS007) were collected northwest of the Foreman Rifle Range (along Shafter Road), and four samples (SMBKGSS001 through SMBKGSS004) were collected in the west-northwest portion of FBH within the Genesee-Sloan soil association. These samples provided background surface soil conditions for the nearby firing ranges that are all within the Genesee-Sloan soil association.

Background surface soil samples were analyzed for semivolatile organic compounds (SVOCs), total metals, pesticides/PCBs, herbicides, ammonia, and nitrate. Surface soil sampling procedures are discussed in Appendix A of the TSP (HLA, 1993a). Surface soil descriptions are presented in Appendix G of this report.

3.2.2 Background Subsurface Soil Samples

Seven soil borings (SMBKGSB001 through SMBKGSB005, SMBKGMW006, and SMBKGMW007) were drilled and sampled at locations identified in Figure 3.2. Upon completion of drilling and sampling, the boreholes were converted to Monitoring Wells SMBKGMW001 through SMBKGMW007. Subsurface soil samples were collected for possible chemical analysis from approximately 1 to 2 feet bgs, 2 to 3 feet bgs, and at 2.5-foot intervals thereafter, to the water table (approximately 6 to 20 feet bgs). Subsurface soil samples from Borings SMBKGMW006 and SMBKGMW007, located along the eastern boundary of FBH were collected for lithologic description only and were not submitted for chemical analysis.

One boring (SMBKGSB001) was sampled continuously to provide a complete lithologic description to the total depth explored (14 feet).

Seven subsurface soil samples per boring were proposed in the TSP (HLA, 1993a) to be selected for chemical analysis from depths corresponding to those sampled at investigation sites. Less than seven subsurface soil samples per boring were actually collected during drilling of Borings SMBKGSB001 through SMBKGSB005, SMBKGMW006, and SMBKGMW007 because shallow groundwater was encountered before collecting all seven subsurface samples per boring, and subsurface soil samples were not collected beneath the water table. Because additional subsurface soil samples were needed to collect seven subsurface samples per subsurface depth interval, eight additional borings (SMBKGSB006 through SMBKGSB011, SMBKGSB04A, and SMBKGSB06A), six more borings than proposed in the TSP (HLA, 1993a), were drilled and sampled throughout FBH. A total of 49 subsurface soil samples were collected over the same depth range as the investigation samples. The locations of these additional borings were selected in areas that appeared not to be influenced by past activities and where groundwater was anticipated to be deeper than at the original boring locations. However, to collect a total of 49 subsurface soil samples, subsurface soil samples from some of these additional borings were collected beneath the water table.

When soil samples from Borings SMBKGSB008 and SMBKGSB009 were received by the laboratory for chemical analysis, the interior temperature of the sample cooler was greater than 4 degrees Celsius (°C) when checked by the laboratory's sample receiving personnel. Because the sample temperature exceeded 4°C, the maximum preservation temperature, their integrity was invalidated. Therefore, replacement soil samples were collected by drilling supplemental Borings SMBKGSB08A and SMBKGSB09A near the original boring locations.

Subsurface soil samples were analyzed for VOCs, SVOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters. Soil boring drilling and sampling procedures are discussed in Appendix A of the TSP (HLA, 1993a). Soil boring logs are presented in Appendix H.

3.2.3 Background Groundwater Samples

A total of seven background monitoring wells was installed in upgradient areas along the FBH boundaries. Five of these background monitoring wells (SMBKGMW001 through SMBKGMW005) were installed along the south and southeast boundary of FBH within five of the background soil borings. The other two monitoring wells (SMBKGMW006 and SMBKGMW007) were installed along the eastern boundary of FBH (Figure 3.2). The 7 new monitoring wells and 10 previously existing monitoring wells (MW16 through MW25) were sampled once during the Phase I RFI to assess shallow background groundwater quality. Before sample collection, the condition of the 10 existing wells was evaluated and assessed to be acceptable for groundwater sampling. Information concerning the evaluation of existing wells is summarized in Table 3.3. Groundwater samples were analyzed for VOCs, SVOCs, total and dissolved metals, pesticides/PCBs, herbicides, cyanide, and landfill parameters. As discussed in Section 3.1.6, monitoring well installation and groundwater sampling procedures are discussed in Appendix A of the TSP (HLA, 1993a). Monitoring well development and sampling procedures were revised from those procedures originally proposed in the TSP (HLA, 1993a).

3.3 Analytical Program

The analytical program for the Phase I EI included analysis of soil-gas, surface soil, subsurface soil, sediment, surface-water, and groundwater samples. The samples were analyzed for various analytical suites including VOCs, SVOCs, dioxins, pesticides/PCBs, herbicides, phenols, metals (total and dissolved), and landfill parameters. The analytical suites for which samples from each of the EI sites were analyzed are presented in the investigation discussion for each of the EI sites provided in Section 4.0. The following sections discuss the analytical parameters and methods, variations to the analytical program during the investigation, and a review of the analytical data quality.

3.3.1 Field Screening Methods

Two field screening methods, soil-gas sampling and analysis and PCB soil screening, were used to provide a real-time initial assessment before collecting samples for laboratory analysis. Soil-gas samples were collected to identify possible presence of TVH and VOCs. Soil-gas samples were analyzed using approved analytical methods that specified the use of a standard gas chromatograph (GC) equipped with a flame ionization detector (FID), and an electron capture detector (ECD).

Soil-gas target analytes were identified by comparing retention times of the investigative sample GC peaks to the retention times determined for GC peaks identified from the analysis of external calibration standards. This comparison of GC peaks is consistent with standard EPA method protocols. Calibration curves were computer-generated by plotting the GC instrument detector response over a 100-fold calibration range of concentration. The detector response was checked at the beginning and end of each day of use.

PCB soil screening was used to assess the approximate concentrations of PCBs in FBH soil. The PCB soil screening procedure is specific for PCBs, and there were no identified interferences from any other chlorinated compounds present at FBH. Selected samples from areas tested during PCB screening were submitted for laboratory testing in accordance with EPA SW-846 Method 8080.

3.3.2 Laboratory Analytical Parameters and Methods

Standardized analytical methods for VOCs, SVOCs, dioxins, pesticides/PCBs, herbicides, phenols, TPH, and metals were modified from "SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA, 1986b). Additional analytical methods were selected from "Methods for Chemical Analysis for Water and Wastes" (EPA, 1983). Table 3.7 presents a summary of analytical methods and associated sample preparation and sample cleanup procedures that were used to analyze soil, sediment, and water samples collected during the RFI. The table also indicates whether the method required USAEC approval before sample analysis. For each analytical suite, a

summary of the analytes and the respective reporting limits for each medium tested is presented in Tables 3.8 through 3.15.

3.3.3 Analytical Data Quality Assessment

The FBH analytical chemistry data quality assessment consisted of evaluating the data with respect to EPA data validation protocols, and USAEC's review of control charts produced by the analytical laboratories.

Results of these data quality assessments indicate that the FBH analytical data are of known and acceptable quality and meet the data quality objectives (DQOs) for the project with the following exceptions:

- The precision of the analytical data was acceptable based on the relative percent difference (RPD) values from duplicate samples with the exception of organochlorine pesticides (OCPs)/PCBs in soil field duplicates. Problems with OCP/PCB RPD values appeared to be due to matrix heterogeneity. Overall, the precision of the data was acceptable.

- The accuracy of the analytical data was acceptable based on the blank sample results, the matrix spike (MS) percent recovery results, and the surrogate percent recovery results. Some target analytes were detected in rinse blank samples; however, the primary source of these analytes appears to be the source water used for rinsing and not the sampling equipment being rinsed. Target analytes were also detected in method blank samples. As per the data validation protocol, detections that are considered to be due to method blank contamination were qualified B and represent 0.7 percent of the RFI analytical data. A review of the MS/matrix spike duplicate (MSD) recoveries indicates that some of the quantitative results for selenium, calcium, and copper were influenced by matrix effects. Average surrogate recoveries for OCP/PCBs were below quality control (QC) limits for one of two OCP/PCB surrogate compounds in the water samples. This indicates that the OCP/PCB water data are less reliable quantitatively than the soil data. Overall, however, the accuracy of the data is acceptable.

- The representativeness of the analytical data was acceptable based on the evaluation of sample selection and collection procedures.

- The overall completeness of the analytical data was 98.4 percent and was considered acceptable. The overall completeness of the collection of field samples for analysis was 104 percent and was considered acceptable.

- The comparability of the analytical data was acceptable based on a review of the FBH procedures.

A more complete discussion of the analytical data quality assessment is presented in Appendix E.

3.4 Environmental Investigation Evaluation Process

The EI evaluation process was designed to review information collected for each EI site, evaluate whether releases of hazardous substance have occurred, and evaluate whether further action is warranted. This evaluation process is described below.

3.4.1 Overview of the Evaluation Process

The purpose of the evaluation process is twofold. First, it serves as a screening mechanism to eliminate from further investigation those EI sites where analytical samples were collected but no constituents exceeded background concentrations. (Analytical samples were not collected at some Phase I EI sites.) The second purpose is to recommend appropriate Phase II activities at sites with one or more constituents exceeding background concentrations. Not all of the EI sites are expected to advance through the entire EI process and require remediation.

The first step in the evaluation process is to compare site analyte concentrations from the Phase I site investigations to background analyte concentrations identified by IDEM. The purpose of this comparison is to evaluate whether the site analyte concentrations exceed background analyte concentrations. If no site analyte concentrations exceed background analyte concentrations, the site is recommended for no further action. The Army will make a formal request to IDEM, at a later time, that no further action be performed at the site, and will provide a decision document for IDEM's approval that will propose the request and provide justification for making the request.

The background analyte concentrations identified by IDEM for screening are conservative and result in the identification of many constituents as exceeding background concentrations. However, exceeding background concentrations does not, by itself, indicate that a release of hazardous substance has occurred at a site. Therefore, further evaluation is required to recommend additional activities.

The second step in the evaluation process is to evaluate the specific analytes found to exceed background and to recommend appropriate Phase II activities for each site. (Site analyte concentrations exceeding background analyte concentrations for each medium sampled are identified and evaluated in Section 4.0 for each EI site.) Constituents exceeding background are reviewed to identify the class of constituents (pesticides, solvents, etc.) and evaluate whether the constituents are related to known site activities. For discussion purposes, the constituents are also compared to commonly used regulatory or guidance levels (regulatory and guidance levels used in the site evaluations are discussed in Section 3.4.3). Based on this evaluation, the sites are recommended for no further action or for additional Phase II investigation. Recommended Phase II investigation activities include additional background sampling and evaluation, additional investigative sampling to evaluate the nature and extent of constituents at the site, human health and ecological risk assessment, and implementation of interim remedial measures. Recommended activities for each EI site are presented in Section 4.0, and a summary of the recommendations is provided in Section 5.2.

3.4.2 Identification of Background Analyte Concentrations

This subsection provides a summary of the identification of background analyte concentrations for use in background screening at FBH.

Background concentrations of many target analytes naturally occur in native soil and groundwater, and are related to geologic materials found at the site and the soil and water chemistry processes that act on these materials. In addition to naturally occurring analytes, low levels of man-made chemicals unrelated to specific sites may be found in an urban environment because of the low detection levels of modern analytical methods.

To identify background analyte concentrations at FBH, 21 surface soil samples, 49 subsurface soil samples, and 17 groundwater samples were collected. These samples were analyzed for VOCs (subsurface soil and groundwater), SVOCs, total metals, dissolved metals (groundwater only),

cyanide, pesticides, PCBs, herbicides, and landfill parameters (including ammonia and nitrites/ nitrates). Analytes detected in background surface and subsurface soil samples included metals, polynuclear aromatic hydrocarbon (PAH) compounds, long-chain hydrocarbons, and pesticides. Analytes detected in background groundwater samples primarily consisted of metals and other inorganic compounds. Analytical results for the FBH background samples are provided in Appendix D.

IDEM reviewed the background analytical results for surface soil, subsurface soil, and groundwater samples to identify the background screening concentrations used in this report. IDEM identified these concentrations (Lorraine Wright, Personal Comm., 1995) by selecting a subset of the background samples that IDEM believes to be representative of background conditions at FBH. (IDEM selected these samples by reviewing sampling locations and analytical results.) The analytical results for these samples were categorized by soil series (surface soil) or sample depth (subsurface soil), and tabulated. Groundwater samples were not categorized prior to tabulating. The maximum target analyte concentration for each category of sample medium was identified as the analyte concentration for background screening.

Background target analyte concentrations provided by IDEM for metals and other inorganic compounds are summarized in Tables 3.16 through 3.25. The tables provided by IDEM include background concentrations for aluminum, calcium, magnesium, and potassium. These naturally occurring elements are not presented and evaluated in Section 4.0 based on a previous agreement among the Army, IDEM, and EPA. Additionally, they are not regulated constituents. However, analytical results for aluminum, calcium, magnesium, and potassium are provided in Appendix C, along with the results of other metal analytes.

Background concentrations for organic compounds and selected landfill parameters are not included in the background concentrations tables. IDEM directed the Army to evaluate concentrations greater

than the detection limit of organic compounds, total organic carbon, ammonia, and nitrites/nitrates as exceeding background. Therefore, all Phase I EI detections of these analytes are presented and evaluated in Section 4.0.

3.4.3 Regulatory and Guidance Levels

The following sections describe commonly used regulatory and guidance levels for constituents identified at sites during the Phase I EI.

3.4.3.1 Maximum Contaminant Levels

The Safe Drinking Water Act (SDWA) establishes MCLs for public drinking water systems (40 Code of Federal Regulations [CFR] Parts 141 and 143). The SDWA MCLs apply to public water systems, which are systems that provide drinking water for human consumption to at least 15 service connections or an average of at least 25 persons daily for at least 60 days of the year.

Target analyte concentrations in groundwater are compared to federal primary and secondary MCLs presented in Table 3.26. Primary MCLs are established on the basis of the protection of human health and consider the technological and economic feasibility of removing the contaminant from the water supply. A safety factor is included in each of the standards to provide adequate protection for sensitive populations that may be at special risk such as infants and children. Secondary MCLs are established to prevent unwanted odor, color, turbidity, or other characteristics that, while not a threat to human health, could present aesthetic considerations.

3.4.3.2 Federal Ambient Water Quality Criteria

Under the authority of the Clean Water Act, EPA has developed federal ambient water quality criteria (AWQC) including criteria for protection of aquatic life. Strategies to incorporate avian and mammalian wildlife into the AWQC regulatory framework is being considered by EPA, but no criteria have been published to date.

Numerical AWQCs published in "Quality Criteria for Water" (EPA, 1986a) represent nonenforceable, scientifically based guidelines for use by states to set water quality standards for protection of aquatic plant and animal life. The numerical AWQC used to compare to target analyte concentrations in FBH surface water are presented in Table 3.27.

3.4.3.3 Soil Polychlorinated Biphenyl Action Levels

The "Guidance on Remedial Actions for Superfund Sites with PCB Contamination" (EPA, 1990a) developed recommended soil PCB action levels for residential and industrial land uses. These action levels consider ingestion, inhalation, and dermal contact with PCB-contaminated soil. For residential areas, an action level of 1 part per million (ppm) is recommended. For industrial areas, where a reduced frequency of exposure is expected, an action level of 10 to 25 ppm is recommended.

3.4.3.4 Soil Lead Screening Level

The revised interim soil lead guidance for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and RCRA sites (EPA, 1994c) recommends a screening level of 400 ppm for lead in soil based on a residential use scenario. If the soil lead concentration is less than 400 ppm, no further action is required unless special circumstances warrant further study. The guidance emphasizes that screening levels are not cleanup goals. The screening levels are to be used to assess which sites or portions of site do not require further investigation and to encourage voluntary cleanup. Lead concentrations exceeding the screening level would not automatically require a removal action.

3.5 Basewide Geology

This section describes the technical approach used to interpret the basewide geology and the results of evaluations and interpretations regarding the geology of the surficial strata.

3.5.1 Technical Approach

To provide a framework for the evaluation of the basewide geology and hydrogeology, eight cross sections were constructed, the locations of which are shown in Figure 3.3. The cross sections were

developed using boring logs from previous studies and boring logs for soil borings drilled by HLA for the EI. The cross sections are illustrated in Figures 3.4 through 3.11. Topography on the cross sections is based on the surveyed ground surface elevations at monitoring wells (shown on Plate 2) and on the contours from the four 7.5′ U.S. Geological Survey (USGS) topographic maps that cover FBH (Indianapolis East [USGS, 1967b]; Cumberland [USGS, 1962b]; Fishers [USGS, 1967a]; and McCordsville [USGS, 1962a]). In addition to the geologic interpretation, the cross sections also show a profile of the water table based on water levels measured on February 14, 1994 (Table 3.25) and on the water-table map illustrated on Plate 1. Cross Sections A-A′, C-C′, D-D′, H-H′, and the eastern four fifths of B-B′ are generally oriented perpendicular to the groundwater flow direction. Cross Sections E-E′, F-F′, G-G′, and the western one fifth of B-B′ are generally oriented parallel to the groundwater flow direction. The depth at which groundwater was first encountered during drilling was usually deeper than the static water level measured after monitoring wells were installed and allowed to stabilize. Therefore, the depth of the first water encountered during drilling was noted on the cross sections (if encountered), but static water-level elevations were used to construct the water-table map.

The quality of the lithologic logs is a function of both the drilling and sampling methods used and the quality of lithologic descriptions. Lithologic logs were prepared by describing soil samples collected from irregular intervals using a 24-inch-long, split-barrel sampler or from soil cuttings between sampling intervals. The details and quality of some of these lithologic logs were limited by poor or no recovery of samples due to the soil type, the density of the soil, obstructions in the sampler (i.e., cobbles, fill material), or loss of samples through the bottom of the split-spoon sampler as it was retracted from the boring.

The geology at FBH was interpreted on the basis of review of boring logs from previous studies and boring logs HLA prepared during the RFI. Boring logs prepared by HLA provide lithological descriptions to a maximum depth of 30 feet bgs.

The quality of the boring logs prepared during previous studies is considered poor because distinct lithologic units were not described for many of these logs. The vagueness and lack of details characterizing the boring logs from previous studies made the continuity of coarse-grained layers in the glacial till (i.e., MW16, MW17, MW18, MW19, and MW22) and in the alluvial deposits (i.e., MW13 and MW15) difficult to assess. Because of the problems described, the boring logs were used to provide limited geologic control and the associated monitoring wells were used only to provide control for ground surface and water-table elevations.

3.5.2 Surficial Geology

The surficial geology at FBH can be divided into two types of unconsolidated deposits: glacial till and alluvium. Terrace and upland soil generally consists of glacial till. Bottomland and the lower portion of the incised creeks generally consist of glacial till interbedded with alluvial deposits derived from reworked glacial till.

3.5.2.1 Glacial Till

The glacial till forming the upland and terrace deposits generally consists of silty clays with minor to moderate amounts of sand and gravel. The upper 20 feet of the upland and terrace deposits are predominantly composed of these silty clays, as illustrated by Cross Sections A-A′, B-B′, C-C′, F-F′, G-G′, and H-H′. The silty clays typically contain 5 to 10 percent sand or gravel with as much as 20 percent sand or gravel locally. Thin, discontinuous clayey to sandy silt and clayey, silty, or gravelly sand form isolated lenses within the silty clay. These silt and sand lenses may be glacio-fluvial or glacial in origin. Where undisturbed, a 3- to 4-foot thick layer of clayey gravel is locally exposed at the surface as illustrated in Cross Sections A-A′, F-F′, and H-H′. Geologic correlations cannot be made between borings drilled deeper than 20 feet due to the long distance between them and the lack of detail of the boring logs from previous studies.

3.5.2.2 Alluvial Deposits

Coarse-grained alluvial deposits occur at depths of 9 to 15 feet bgs under portions of the glacial till or flood plain deposits in the bottomland around the lower elevation of Lawrence Creek, as illustrated in Cross Sections D-D′ and E-E′ and in the flood plain of Fall Creek. The alluvial deposits consist of fine- to coarse-grained sand with silt, silty sand with fine- to coarse-grained gravel, and sandy fine- to coarse-grained gravel. These coarse-grained deposits probably represent a channel facies and may provide a preferential pathway for groundwater flow. These deposits are poorly sorted, consistent with the deposition of alluvial deposits having a proximal glacial source. In addition, both the sand grains and gravel are subrounded to subangular, further indicating that they have not been transported long distances.

3.6 Basewide Hydrogeology

Most of the previous literature concerning the hydrogeology at FBH indicates that groundwater in the glacial till is perched in localized lenses of sand and gravel and that the surrounding silty clay confines these isolated lenses. However, the conditions encountered during the Phase I EI drilling activities indicate that the hydrogeology of the shallow groundwater system is different than previously described. The hydrogeologic conditions encountered do not indicate that the shallow groundwater flow system is confined. Rather, the groundwater at FBH most likely represents a shallow unconfined groundwater flow system within a relatively low permeability and heterogeneous lithology. A continuous unconfined flow system at FBH is indicated by evaluation of data collected from the monitoring wells installed at several sites. The water table was not identifiable during drilling, and the silty clays did not appear to be saturated. However, after the monitoring wells were installed, the water levels rose and stabilized in these wells (screened in silty clays) at levels consistent with the local water table at FBH (Plate 1). The silty clays are expected to be of relatively lower permeability than the sands and gravels such that groundwater flow is restricted through the clays; however, a limited amount of groundwater does move through the clays.

Water-level measurements were obtained February 14, 1994, shown in Table 3.28, and were used to produce a water-table map for the unconfined flow system. Water-level elevations for each monitoring well were plotted, and the water-table surface was interpolated using a 5-foot contour interval. Groundwater flow direction is typically controlled by topography, as illustrated by the groundwater map and the cross sections. The basewide flow is generally to the northwest with local variations. The drop in the water-table elevation from southeast to northwest across FBH is approximately 120 feet. The typical hydraulic gradient is approximately 0.008 in the upland terraces, 0.02 along the steeper slopes, and 0.008 in the bottomland.

The water table intersects Schoen Creek, Lawrence Creek, and Fall Creek in the western and northwestern portions of FBH. Schoen Creek, which flows to the northwest, discharges into Lawrence Creek, flowing to the northeast and the north. Lawrence Creek also acts as a discharge area for the groundwater flowing from the southeast that intersects it as illustrated on Cross Sections B-B′, D-D′, and E-E′. Fort Branch, located in the central and northern portions of FBH, acts as a discharge area for the groundwater that intersects it, as illustrated on Cross Section H-H′. Fall Creek, flowing to the southwest, is assumed to be the regional discharge area for shallow groundwater and surface water. Lawrence Creek, Mud Creek, Fort Branch, Camp Creek, and Indian Creek discharge into Fall Creek within the FBH boundaries. Delaware Lake, New Lake, and the Duck Pond act as local discharge and recharge areas for the groundwater.

Hydraulic conductivity is controlled by the lithologic characteristics of the strata through which the groundwater flows. At FBH, the surficial geology of the upland and sloping terrace areas is predominantly composed of silty clays, as discussed in Section 3.5.2. These silty clays have a very low permeability and are expected to inhibit groundwater flow; groundwater may be perched locally. As evidence of the relatively lower permeability of the silty clays, the clays appeared to be unsaturated during drilling, and the first water encountered was often noted at the top of a silt or sand lens, where present. However, the static water level was at a higher level than first encountered water

when the monitoring well was allowed to equilibrate, indicating that the water table also exists in the silty clays.

Table 3.1: Summary of Phase I EI Activities

Site Identification	Geophysics	Soil-gas Sampling	PCB (Field Screening)	Surface Soil Sampling	Soil Borings and Subsurface Soil Sampling	Monitoring Well Installation and Groundwater Sampling	Surface-Water Sampling	Sediment Sampling	Land Survey
EI Site 1 Auto Craft Shop, Building 705	---	Three samples collected; collection of nineteen additional samples attempted but soil was too impermeable	---	---	Five borings total drilled to the water table; three samples per boring were collected for chemical analysis; because sample integrity was invalidated Boring SB003 was replaced by SB03A from which three samples were collected	Four wells installed; one round of groundwater sampling	---	---	Four new monitoring wells
EI Site 3 Former Post Exchange Gasoline Station, Building 619	---	Fourteen samples collected; collection of six additional samples was attempted but soil was too impermeable	---	---	Five borings total drilled to the water table; three samples per boring were collected for chemical analysis	Four wells installed; one round of groundwater sampling	---	---	Four new monitoring wells
EI Site 4 · DIS Engineering/ Maintenance Building 26	---	Fourteen samples collected; collection of twenty additional samples attempted but soil was too impermeable	28 samples collected and screened for PCBs	Three samples collected for PCB analysis	Five borings total drilled to the water table; three samples per boring were collected for chemical analysis	Four wells installed; one round of groundwater sampling	---	---	Four new monitoring wells

Table 3.1 (Continued)

Site Identification	Geophysics	Soil-gas Sampling	PCB (Field Screening)	Surface Soil Sampling	Soil Borings and Subsurface Soil Sampling	Monitoring Well Installation and Groundwater Sampling	Surface-Water Sampling	Sediment Sampling	Land Survey
EI Site 5 Electrical Shop, Building 4	---	---	21 samples collected and screened for PCBs	Five samples collected for TPH analysis; two samples collected for PCB analysis	Five borings total; three samples per boring were collected for PCB and TPH analysis	---	---	---	---
EI Site 6 Former Coal Storage Yard, Building 2	---	---	---	Ten samples collected for total metals analysis	Ten borings total drilled to approximately 3 feet; one sample collected from each boring for pH and total metals analysis	---	---	---	---
EI Site SM18 Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27	---	---	---	---	---	---	Two samples collected from basement of Building 27	Three samples collected from basement of Building 27	---
EI Site SM19 Pesticide Mixing and Storage Areas, Building 514	---	---	---	Twelve samples collected from the area surrounding Building 514	---	---	---	---	---
EI Site SM20 Pesticide Mixing and Storage Areas, DIS Entomology Building 605	Borehole clearance	---	---	Twelve samples collected from the area near Buildings 604 and 605	Four borings to a depth of 3.5 - 4 feet in area north to northeast of Building 605; one sample per boring was collected for chemical analysis	---	One upstream and one downstream sample collected from drainage channel northeast of Building 605	One upstream and one downstream sample collected from drainage channel northeast of Building 605	---

Table 3.1 (Continued)

Site Identification	Geophysics	Soil-gas Sampling	PCB (Field Screening)	Surface Soil Sampling	Soil Borings and Subsurface Soil Sampling	Monitoring Well Installation and Groundwater Sampling	Surface-Water Sampling	Sediment Sampling	Land Survey
EI Site SM21 Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, west of Building 674	---	---	---	Twelve samples collected from area near Building 674	---	---	---	Two sediment samples collected from drainage channel south of Building 674, on north side of Shafter Road	---
EI Site SM22 Firing Range, Foreman Rifle Range, near Buildings 811 and 812	---	---	---	Twenty-two samples collected at 11 locations from hillside impacted by firing range use; at each sampling location, one sample for chemical analysis, one sample for bullet fragment analysis	Five borings to a depth of 3 feet along firing range hillside; one sample per boring for chemical analysis; bullet fragment analysis on remainder of sample	---	Two samples collected from Schoen Creek; one upstream and one downstream of the impacted firing range hillside	Two samples collected in streambed of Schoen Creek; one upstream and one downstream of impacted firing range hillside	---
EI Site SM23 Firing Range, State Police Pistol Range, near Building 815	---	---	---	Twenty samples collected at 10 locations from hillside impacted by firing range use; at each sampling location, one sample for chemical analysis, one sample for bullet fragment analysis	Five borings to a depth of 3 feet along firing range hillside; one sample per boring for chemical analysis; bullet fragment analysis on remainder of sample	---	Two samples collected from Lawrence Creek; one upstream and one downstream of the impacted firing range hillside	Two samples collected in streambed of Lawrence Creek; one upstream and one downstream of the impacted firing range hillside	---

Table 3.1 (Continued)

Site Identification	Geophysics	Soil-gas Sampling	PCB (Field Screening)	Surface Soil Sampling	Soil Borings and Subsurface Soil Sampling	Monitoring Well Installation and Groundwater Sampling	Surface-Water Sampling	Sediment Sampling	Land Survey
EI Site SM24 Firing Range, Skeet/Rifle Range, near Buildings 819 through 822	---	---	---	Thirty-four samples collected at 17 locations within area of range impacted by spent shot/bullets; at each sampling location, one sample for chemical analysis, one sample for shot/bullet fragment analysis.	Six borings to a depth of 3 feet within area of range impacted by spent shot/bullets; one sample per boring for chemical analysis; shot/bullet fragment analysis on remainder of sample	---	---	---	---
EI Site SM25a*	---	---	---	---	---	---	---	---	---
EI Site SM25b	Limited geophysical survey using GPR, EM	---	---	Six samples collected for chemical analysis	One hand-augered test boring to 5 feet bgs to evaluate potential for subsurface debris. No samples collected.	---	---	---	---
EI Site SM25c	Geophysical survey using GPR, EM, and borehole clearance	Two samples collected; collection of three additional samples was attempted but soil was too impermeable	---	---	Five borings to a depth approximately 5 feet beneath fill material; two samples per boring were collected for chemical analysis; one from fill, one from native soil below fill, except three samples were collected for SB001	---	---	---	---
EI Site SM25d*	---	---	---	---	---	---	---	---	---

Table 3.1 (Continued)

Site Identification	Geophysics	Soil-gas Sampling	PCB (Field Screening)	Surface Soil Sampling	Soil Borings and Subsurface Soil Sampling	Monitoring Well Installation and Groundwater Sampling	Surface-Water Sampling	Sediment Sampling	Land Survey
EI Site SM25e*	---	---	---	---	---	---	---	---	---
EI Site SM25f	Geophysical survey using GPR, EM, and borehole clearance	Four samples collected, collection of 11 additional samples was attempted but soil was too impermeable	---	---	Three borings to a depth of approximately 5 feet beneath fill material; two samples per boring were collected for chemical analysis; one from fill, one from native soil below fill. Three replacement borings were drilled/sampled to replace samples that arrived at laboratory above preservation temperature of 4°Celsius.	---	---	---	---
EI Site SM25g*	---	---	---	---	---	---	---	---	---
EI Site SM25h	---	---	---	Six samples collected for chemical analysis	---	---	---	---	---
EI Site SM25i	Geophysical survey using GPR, EM	---	---	Six samples collected for chemical analysis	One hand-augered test boring to 5 feet bgs to evaluate potential for subsurface debris. No samples collected.	---	---	---	---

Table 3.1 (Continued)

Site Identification	Geophysics	Soil-gas Sampling	PCB (Field Screening)	Surface Soil Sampling	Soil Borings and Subsurface Soil Sampling	Monitoring Well Installation and Groundwater Sampling	Surface-Water Sampling	Sediment Sampling	Land Survey
EI Site SM25j	Geophysical survey using GPR, EM	---	---	Six samples collected for chemical analysis	One hand-augered test boring to 5 feet bgs to evaluate potential for subsurface debris. No samples collected.	---	---	---	---
EI Site SM25k	---	---	---	Six samples collected for chemical analysis	---	---	---	---	---
EI Site SM25l	---	---	---	---	---	---	---	---	---
EI Site SM26 Former Sewage Treatment Plant (West of Building 674)	Geophysical survey using GPR, EM	---	---	---	---	---	---	---	---
EI Site SM27 Former Sewage Treatment Plant, (North of Building 509)	Geophysical survey using GPR, EM	---	---	---	---	---	---	---	---
EI Site SM28 Wash Racks, Grease Racks, Oil/Water Separators*	---	---	---	---	---	---	---	---	---
EI Site SM29 Patriotic Site*	---	---	---	---	Two samples collected from base of excavation pit for chemical analysis.	---	---	---	---

Table 3.1 (Continued)

---	No analysis
DIS	Directorate of Installation Support
EM	Electromagnetics
GPR	Ground penetrating radar
PCB	Polychlorinated biphenyl
SWMU	Solid waste management unit
TPH	Total petroleum hydrocarbons

* Investigation sampling was not performed at this site because there was no evidence to indicate that hazardous waste or hazardous constituents were potentially released into the environment.
# A records/permit review was performed for EI Site SM28; a records review and interview of Army personnel was performed for EI Site SM29.

Table 3.2: Summary of Phase I EI Samples and Analyses

Site Identification/ Sampling Media	Chemical Parameters									Physical Parameters
				Metals						
	VOCs	SVOCs	TPH	Total	Dissolved*	PCBs (Field Screening)	Pesticides/ PCBs	Herbicides	Landfill Parameters	Metal Mass (Field Screening)
EI Site 1										
Soil gas	3									
Subsurface soil	15		15	15						
Groundwater	4		4							
EI Site 3										
Soil gas	14									
Subsurface soil	15		15	15						
Groundwater	4		4							
EI Site 4										
Soil gas	19									
Surface soil						28	3			
Subsurface soil	15	15	15	15						
Groundwater	4	4	4	4	4					
EI Site 5										
Surface soil			5			21	2			
Subsurface soil			15				15			
EI Site 6										
Surface soil				10						
Subsurface soil				7						
EI Site SM18										
Surface water				2	2		2	2		
Sediment				3			3	3		
EI Site SM19										
Surface soil							12	12		

Table 3.2 (Continued)

Site Identification/ Sampling Media	Chemical Parameters									Physical Parameters
				Metals						
	VOCs	SVOCs	TPH	Total	Dissolved*	PCBs (Field Screening)	Pesticides/ PCBs	Herbicides	Landfill Parameters	Metal Mass (Field Screening)
EI Site SM20										
Surface soil							12	12		
Subsurface soil							4	4		
Surface water							2	2		
Sediment							2	2		
EI Site SM21										
Surface soil							12	12		
Sediment							2	2		
EI Site SM22										
Surface soil				11						11
Subsurface soil				5						5
Surface water				2	2					
Sediment				2						
EI Site SM23										
Surface soil				10						10
Subsurface soil				5						5
Surface water				2	2					
Sediment				2						
EI Site SM24										
Surface soil				17						17
Subsurface soil				6						6
EI Site SM25a										
EI Site SM25b										
Surface soil	6	6		6			6	6	6	
EI Site SM25c										
Soil gas	2									
Subsurface soil	11	11		11			11	11	11	
EI Site SM25d										

Table 3.2 (Continued)

Site Identification/ Sampling Media	Chemical Parameters									Physical Parameters
				Metals						
	VOCs	SVOCs	TPH	Total	Dissolved*	PCBs (Field Screening)	Pesticides/ PCBs	Herbicides	Landfill Parameters	Metal Mass (Field Screening)
EI Site SM25e										
EI Site SM25f										
Soil gas	4									
Subsurface soil	6	6		6			6	6	6	
EI Site SM25g										
EI Site SM25h										
Surface soil	6	6		6			6	6	6	
EI Site SM25i										
Surface soil	6	6		6			6	6	6	
EI Site SM25j										
Surface soil	6	6		6			6	6	6	
EI Site SM25k										
Surface soil	6	6		6			6	6	6	
EI Site SM25l										
EI Site SM26										
EI Site SM27										
EI Site SM28										
EI Site SM29										
Subsurface soil	2	2								

Table 3.2 (Continued)

Site Identification/ Sampling Media	Chemical Parameters									Physical Parameters
				Metals						
	VOCs	SVOCs	TPH	Total	Dissolved*	PCBs (Field Screening)	Pesticides/ PCBs	Herbicides	Landfill Parameters	Metal Mass (Field Screening)
EI Site Totals										
Soil gas	49									
Surface soil	30	30	5	78		49	115	66	30	38
Subsurface soil	64	32	60	85			21	21	17	11
Groundwater	12	4	12	4	4					
Surface water			6	6		4	4			
Sediment			7			7	7			

PCB Polychlorinated biphenyl
SVOC Semivolatile organic compound
SWMU Solid waste management unit
TPH Total petroleum hydrocarbons
VOC Volatile organic compound

* Water samples collected for dissolved metals analysis were filtered through a 0.45-micron filter.

Table 3.3: Existing Monitoring Well Evaluation Results

Well #	Site ID	Well Head Construction	Well Casing Material	Well Casing I.D. (inches)	Well Screen Interval bgs (feet)	Well Cap		Depth to Water from Ref. Pt. (feet)	Total Depth of Well from Ref. Pt. (feet)	Length of Well Casing ags or bgs (feet)	Comments	Recommendations
						Type	Material					
MW01	West Landfill	Aboveground	PVC	2	18 to 28	Screw-on	Metal	19.91	33.19	2.22	No steel riser pipe around casing. 5-foot x 5-foot metal frame surrounding PVC casing used as well protection. Cannot see concrete pad because 2- to 3-inch diameter rocks surrounding casing at base. Well cap is very rusted, and hard to open/close.	
MW02	West Landfill	Aboveground	PVC	2	21 to 31	Slip-on	PVC	6.82	37.34	3.39	No steel riser pipe or 5-foot x 5-foot metal frame around casing for protection. Cannot see concrete pad or rock protection; only dirt cover surrounding casing base. No lock.	
MW03	West Landfill	Aboveground	PVC	2	31 to 41	Screw-on	Metal	30.91	42.50	3.43	No steel riser pipe around casing. 5-foot x 5-foot metal frame surrounding PVC casing used as well protection. Cannot see concrete pad because 2- to 3-inch diameter rocks surrounding casing at base.	

Table 3.3 (Continued)

Well #	Site ID	Well Head Construction	Well Casing Material	Well Casing I.D. (inches)	Well Screen Interval bgs (feet)	Well Cap Type	Well Cap Material	Depth to Water from Ref. Pt. (feet)	Total Depth of Well from Ref. Pt. (feet)	Length of Well Casing ags or bgs (feet)	Comments	Recommendations
MW04	West Landfill	Aboveground	PVC	2	40 to 50	Screw-on	Metal	45.56	56.55	2.84	No steel riser pipe around casing. 5-foot x 5-foot metal frame surrounding PVC casing used as well protection. Cannot see concrete pad because 2- to 3-inch diameter rocks surrounding casing at base. Well cap is very rusted, and hard to open/close.	
MW05	West Landfill	Aboveground	PVC	2	14 to 24	Screw-on	Metal	10.12	30.44	2.10	No steel pipe around casing. 5-foot x 5-foot metal frame surrounding PVC casing used as well protection. Cannot see concrete pad because 2- to 3-inch diameter rocks surrounding casing at base.	
MW06	West Landfill	Aboveground	PVC	2	14 to 24	No cap	N/A	10.22	26.66	2.27	Cannot see concrete pad or seal; appears as if mud is surrounding casing. Casing could use slip-on cap. Surface water could enter well directly because no cap present. About 1 to 2 inches of silt on water- level indicator probe.	

Table 3.3 (Continued)

Well #	Site ID	Well Head Construction	Well Casing Material	Well Casing I.D. (inches)	Well Screen Interval bgs (feet)	Well Cap		Depth to Water from Ref. Pt. (feet)	Total Depth of Well from Ref. Pt. (feet)	Length of Well Casing ags or bgs (feet)	Comments	Recommendations
						Type	Material					
MW07	SE of EI Site #5, Electrical Shop, Bldg. 2	Aboveground	PVC	2	24 to 34	No cap	N/A	8.52	36.32	1.46	Grout seal appears to consist of soil (clay) built up to 4 inches below TOC. Casing could use slip-on cap. Surface water could enter well directly because no cap present. Surface water could also drain through grout seal if it is broken or made of soil allowing the water to flow into the casing through the screen or a crack. No lock.	
MW08	W of EI Site #5, Electrical Shop, Bldg. 2	Aboveground	PVC	2	10 to 20	Slip-on	PVC	6.42	22.02	2.03	Lid hard to open/close because hinge was sheared. Cannot see concrete pad because riser base is covered by soil and gravel. Grout seal appears to consist of soil (clay) built up to 4 inches below TOC with a white coating seal. Casing could use slip-on cap. Surface water could enter well directly because no cap present. Surface water could drain through grout seal if it is broken or made of soil allowing the water to flow into the casing through the screen or a crack.	
MW09	NW of EI Site #5, Electrical Shop, Bldg. 2	Aboveground	PVC	2	8.5 to 18.5	Slip-on	PVC	5.92	21.22	1.48	Cannot see concrete pad because riser base is covered by soil and gravel. No lock.	

Table 3.3 (Continued)

Well #	Site ID	Well Head Construction	Well Casing Material	Well Casing I.D. (inches)	Well Screen Interval bgs (feet)	Well Cap Type	Well Cap Material	Depth to Water from Ref. Pt. (feet)	Total Depth of Well from Ref. Pt. (feet)	Length of Well Casing ags or bgs (feet)	Comments	Recommendations
MW10	N of EI Site #5, Electrical Shop, Bldg. 2	Aboveground	PVC	2	10 to 25	Slip-on	PVC	9.79	28.16	1.57	Cannot see concrete pad because riser base is covered by grassy soil.	
MW11	NE of EI Site #5, Electrical Shop, Bldg. 2	Aboveground	PVC	2	9 to 19	No cap	N/A	5.20	11.11	1.87	Lid to box is twisted and plates for lock are bent. Cannot see concrete pad because riser base is surrounded by asphalt and gravel. Seal is breaking up into small chunks. Surface water could enter well casing because no cap is present and the lid does not close for good seal. Casing could use slip-on cap.	
MW12	S of SWMU #FBH11, Former Sewage Treatment Plant, Bldg. 810	Aboveground	PVC	2	39.02 to 54.02	Screw-on	PVC	33.23	56.22	0.89	Wellhead is in good condition.	
MW13	NW of SWMU #FBH11, Former Sewage Treatment Plant, Bldg. 810	Aboveground	PVC	2	12.74 to 27.74	Screw-on	PVC	15.01	30.22	2.12	Concrete pad is cracked with air space present between steel riser and concrete pad.	Possible wellhead repair
MW14	N of SWMU #FBH11, Former Sewage Treatment Plant, Bldg. 810	Aboveground	PVC	2	8.26 to 23.26	Slip-on	PVC	13.29	25.31	1.46	Concrete pad is broken into chunks with air space present between steel riser and concrete pad.	Possible wellhead repair

Table 3.3 (Continued)

Well #	Site ID	Well Head Construction	Well Casing Material	Well Casing I.D. (inches)	Well Screen Interval bgs (feet)	Well Cap Type	Well Cap Material	Depth to Water from Ref. Pt. (feet)	Total Depth of Well from Ref. Pt. (feet)	Length of Well Casing ags or bgs (feet)	Comments	Recommendations
MW15	NE of SMWU #FBH11, Former Sewage Treatment Plant, Bldg. 810	Aboveground	PVC	2	6.15 to 21.15	Slip-on	PVC	13.80	24.36	2.00	Well depth measurements taken from northeast corner of well casing. Wellhead is in good condition.	
MW16	W of Lee Road, SE Corner of Golf Course	Aboveground	PVC	2	8.89 to 13.89	Screw-on	PVC	2.40	15.35	0.85	Wellhead is in good condition.	Sample
MW17	W of Lee Road, E of entrance to SWMU #FBH-19, Pesticide Storage Area, Bldg. 514	Aboveground	PVC	2	8.33 to 18.33	Screw-on	PVC	3.35	19.59	1.73	Concrete pad is cracked.	Sample
MW18	E of Lee Road, N of entrance to SWMU #FBH-17, Bldg. 518	Aboveground	PVC	2	23.98 to 43.98	Slip-on	PVC	4.08	44.11	-0.10	Riser lid has 1-inch deep depression about 6-inches in diameter. Concrete pad is broken. Surface water may be draining into casing because the grout seal is broken; approximately 4 inches of water above the seal.	Sample
MW19	E of Lee Road, S of entrance to SWMU #FBH-17, Bldg. 518	Aboveground	PVC	2	27.73 to 37.73	Slip-on	PVC	8.10	38.52	-0.01	Well depth measurements taken from southeast corner of well casing.	Sample
MW20	NW of Helipad to Hawley Hospital, in tall weeds	Aboveground	PVC	2	2.97 to 12.97	Screw-on	PVC	4.46	15.48	1.95	N/A	Sample

Table 3.3 (Continued)

Well #	Site ID	Well Head Construction	Well Casing Material	Well Casing I.D. (inches)	Well Screen Interval bgs (feet)	Well Cap Type	Well Cap Material	Depth to Water from Ref. Pt. (feet)	Total Depth of Well from Ref. Pt. (feet)	Length of Well Casing ags or bgs (feet)	Comments	Recommendations
MW21	NE of Helipad to Hawley Hospital	Aboveground	PVC	2	13.69 to 23.69	Screw-on	PVC	3.45	25.40	1.25	N/A	Sample
MW22	N of softball fields, E of Hawley Hospital	Aboveground	PVC	2	8.74 to 18.74	Screw-on	PVC	4.55	20.33	1.27	Concrete pad is broken with parts missing around riser. Seal is starting to break up with crusty concrete around casing.	Sample
MW23	E of softball fields, E of Hawley Hospital	Aboveground	PVC	2	8.57 to 18.57	Screw-on	PVC	3.44	20.49	1.35	Lock is rusty and hard to open. Concrete pad is broken around riser, with small chunks of concrete at riser base.	Sample
MW24	W of Lee Road, N of path to confidence course	Aboveground	PVC	2	8.69 to 18.69	Screw-on	PVC	6.05	20.34	1.70	Concrete pad is broken on north side of steel riser, but no air space present between steel riser and concrete pad.	Sample
MW25	NE of Helipad to Hawley Hospital	Aboveground	PVC	2	13.58 to 18.58	Expandable w/slip	PVC	3.64	15.36	1.37	Slip-on cap on top of expandable screw-on riser.	Sample
LRC1	SW well on SWMU #FBH8, Former Drum Storage Area	Flush mount	PVC	2	---	Screw-on	PVC	1.25	17.05	N/A	Abandoned January 1994	N/A
LRC2	SE well on SWMU #FBH8, Former Drum Storage Area	Flush mount	PVC	2	---	Screw-on	PVC	0.00	16.00	N/A	Abandoned January 1994	N/A

Table 3.3 (Continued)

Well #	Site ID	Well Head Construction	Well Casing Material	Well Casing I.D. (inches)	Well Screen Interval bgs (feet)	Well Cap		Depth to Water from Ref. Pt. (feet)	Total Depth of Well from Ref. Pt. (feet)	Length of Well Casing ags or bgs (feet)	Comments	Recommendations
						Type	Material					
LRC3	NW well on SWMU #FB-H8, Former Drum Storage Area	Flush mount	PVC	2	---	Screw-on	PVC	0.00	16.00	N/A	Abandoned January 1994	N/A
LRC4	NE well on SWMU #FBH8, Former Drum Storage Area	Flush mount	PVC	2	---	Screw-on	PVC	0.58	16.88	N/A	Abandoned January 1994	N/A

--- Not relevant, samples not collected
ags Above ground surface
bgs Below ground surface
ID Identification
I.D. Inside diameter
N/A Does not apply
PVC Polyvinyl chloride
Ref. Pt. Reference point
TOC Top of casing

Table 3.4 Monitoring Wells Sampled During the Phase I Environmental Investigation

Background Assessment		EI Site Assessment	
Well Number	Date Sampled	Well Number	Date Sampled
SMBKGMW001	2/02/94	EI001MW001	2/02/94
SMBKGMW002	2/03/94	EI001MW002	2/02/94
SMBKGMW003	2/03/94	EI001MW003	2/02/94
SMBKGMW004	2/04/94	EI001MW004	2/03/94
SMBKGMW005	2/05/94	EI003MW001	2/03/94
SMBKGMW006*	2/05/94	EI003MW002	2/16/94
SMBKGMW007	2/05/94	EI003MW003	2/16/94
MW16*	1/26/94	EI003MW004	2/16/94
MW17*	1/29/94	EI004MW001	2/04/94
MW18	1/28/94	EI004MW002	2/06/94
MW19	1/27/94	EI004MW003	2/05/94
MW20	1/31/94	EI004MW004	2/05/94
MW21	1/31/94	12 wells	
MW22	1/27/94		
MW23	1/28/94		
MW24*	1/30/94		
MW25	1/30/94		
17 wells including MW20			

EI Environmental investigation

* Review of analytical results indicated potential impact from East Landfill

Table 3.5 Description and Rationale for Background Soil and Groundwater Sampling Locations

Sample ID	Description of Sample/ Soil Boring Location	Rationale
Soil Boring/Subsurface Soil		
SMBKGSB001	Grassy area not regularly mowed; small drainage ditch to the east, larger drainage ditch to the south.	To assess ambient subsurface soil conditions along the southern boundary of the base.
SMBKGSB002	Grassy area regularly mowed; a paved roadway leading to the Bean Center parking lot is to the north; a large drainage ditch is to the south.	To assess ambient subsurface soil conditions along the southern boundary of the base.
SMBKGSB003	Seasonal wetlands area; flooding during periods of heavy rain; railroad tracks and a drainage channel are located to the southeast.	To assess ambient subsurface soil conditions along the southeast boundary of the base.
SMBKGSB004 SMBKGSB04A	Grassy field not regularly mowed; Aultman Avenue located to the north; railroad tracks and a drainage channel to the southeast.	To assess ambient subsurface soil conditions along the southeast boundary of the base.
SMBKGSB005	Grassy field not regularly mowed; two buildings located to the north; railroad tracks and a drainage channel located to the southeast.	To assess ambient subsurface soil conditions along the southeast boundary of the base.
SMBKGSB006 SMBKGSB06A	Grassy field not regularly mowed.	To assess ambient subsurface soil conditions south-southwest of the center
SMBKGSB007	Along the edge of a forested and grassy area; the grassy area is regularly mowed.	To assess ambient subsurface soil conditions northwest of the center of the base.
SMBKGSB008 SMBKGSB08A	Grassy field not regularly mowed; two buildings located to the north; railroad tracks and a drainage channel located to the southeast.	To assess ambient subsurface soil conditions along the southeast boundary of the base.
SMBKGSB009 SMBKGSB09A	Grassy field not regularly mowed; dirt road, railroad and a drainage channel are located to the southeast.	To assess ambient subsurface soil conditions along the southeast boundary of the base.
SMBKGSB010	Along the edge of a forested and grassy area northwest of a paved running track.	To assess ambient subsurface soil conditions east of the center of the base.

Table 3.5 (continued)

Sample ID	Description of Sample/ Soil Boring Location	Rationale
SMBKGSB011	Along the edge of a forested area; a paved road is located north of the boring location.	To assess ambient subsurface soil conditions north-northwest of the center of the base.
Surface Soil		
SMBKGSS001	Black walnut orchard.	To assess ambient surface soil conditions within the Genesee-Sloan soil association in the northwest portion of the base.
SMBKGSS002	Black walnut orchard.	To assess ambient surface soil conditions within the Genesee-Sloan soil association in the northwest portion of the base.
SMBKGSS003	Black walnut orchard.	To assess ambient surface soil conditions within the Genesee-Sloan soil association in the northwest portion of the base.
SMBKGSS004	Black walnut orchard.	To assess ambient surface soil conditions within the Genesee-Sloan soil association in the northwest portion of the base.
SMBKGSS005	Grassy field regularly mowed; Shafter Road to the northeast and Schoen Creek to the west.	To assess ambient surface soil conditions within the Genesee-Sloan soil association northwest of the center of the base.
SMBKGSS006	Grassy field regularly mowed; Shafter Road to the northeast and Schoen Creek to the southwest.	To assess ambient surface soil conditions within the Genesee-Sloan soil association northwest of the center of the base.
SMBKGSS007	Grassy field regularly mowed; Shafter Road to the northeast and Schoen Creek to the south.	To assess ambient surface soil conditions within the Genesee-Sloan soil association northwest of the center of the base.
SMBKGSS008	Grassy field not regularly mowed.	To assess ambient surface soil conditions within the Miami-Crosby soil association southwest of the center of the base.
SMBKGSS009	Grassy field not regularly mowed.	To assess ambient surface soil conditions within the Miami-Crosby soil association southwest of the center of the base.
SMBKGSS010	Grassy field not regularly mowed.	To assess ambient surface soil conditions within the Miami-Crosby soil association southwest of the center of the base.

Table 3.5 (continued)

Sample ID	Description of Sample/ Soil Boring Location	Rationale
SMBKGSS011	Large grassy field; a former runway was located to the southeast.	To assess ambient surface soil conditions within the Crosby-Brookston soil association in the southwest portion of the base.
SMBKGSS012	Large grassy field; a former runway was located to the southeast.	To assess ambient surface soil conditions within the Crosby-Brookston soil association in the southwest portion of the base.
SMBKGSS013	Large grassy field; a former runway was located to the southeast.	To assess ambient surface soil conditions within the Crosby-Brookston soil association in the southwest portion of the base.
SMBKGSS014	Along southern edge of a seasonal wetlands area; A drainage channel and rail road tracks are located to the southeast.	To assess ambient surface soil conditions within the Crosby-Brookston soil association in the southeast portion of the base.
SMBKGSS015	Along edge of grassy field not regularly mowed; a drainage channel and railroad tracks are located to the southeast of the sample location.	To assess ambient surface soil conditions within the Crosby-Brookston soil association in the southeast portion of the base.
SMBKGSS016	Grass field that is regularly mowed.	To assess ambient surface soil conditions within the Crosby-Brookston soil association in the east portion of the base.
SMBKGSS017	Grass field that is regularly mowed.	To assess ambient surface soil conditions within the Crosby-Brookston soil association in the east portion of the base.
SMBKGSS018	Forested area.	To assess ambient surface soil conditions within the Miami-Crosby soil association northeast of the center of the base.
SMBKGSS019	Forested area.	To assess ambient surface soil conditions within the Miami-Crosby soil association northeast of the center of the base.
SMBKGSS020	Forested area.	To assess ambient surface soil conditions within the Miami-Crosby soil association in the northeast portion of the base.
SMBKGSS021	Forested area.	To assess ambient surface soil conditions within the Miami-Crosby soil association in the northeast portion of the base.

Table 3.5 (continued)

Sample ID	Description of Sample/ Soil Boring Location	Rationale
Monitoring Wells		
SMBKGMW001	Southern boundary of base.	To assess groundwater quality upgradient of the base.
SMBKGMW002	Southern boundary of base.	To assess groundwater quality upgradient of the base.
SMBKGMW003	Southeast boundary of base.	To assess groundwater quality upgradient of the base.
SMBKGMW004	Southeast boundary of base.	To assess groundwater quality upgradient of the base
SMBKGMW005	Southeast boundary of base.	To assess groundwater quality upgradient of the base
SMBKGMW006	East boundary of base.	To assess groundwater quality down-gradient of the East Landfill.
SMBKGMW007	East boundary of base.	To assess groundwater quality upgradient of the East Landfill

Table 3.6: Summary of Phase I Sampling Activities at Background Sites

Activity	Analytes	Locations	Intended Objective
Surface soil sampling	SVOCs, total metals, pesticides/ PCBs, herbicides, ammonia, and nitrate	Twenty-one surface soil samples southwest of Building 1, west of the Officer family housing area and along Shafter Road northwest of the Foreman Rifle Range, along the southeast and east margin of FBH, and in the northeast and northwest portion of FBH.	To provide ambient surface soil conditions relative to investigative surface soil sampling locations.
Soil borings and subsurface soil sampling	VOCs, SVOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters	Seven soil borings along the south, southeast, and east margin of FBH; two soil borings near the Foreman Rifle Range and Officer family housing; subsurface soil samples will be collected from each boring from approximately 1 to 2 feet bgs, 2 to 3 feet bgs, and at 2.5-foot intervals to the water table; seven samples per boring for chemical analyses. Soil samples from two borings along the eastern margin of FBH will be collected for lithologic description only.	To assess ambient target analyte concentrations in subsurface soil.
Monitoring well installation and groundwater sampling	VOCs, SVOCs, total and dissolved metals, pesticides/PCBs, herbicides, and landfill parameters	Five monitoring wells collocated with background soil borings along the south and southeast margin of FBH; two monitoring wells along the eastern boundary of FBH, one groundwater sample collected from each newly installed monitoring well in addition to existing Wells MW16 through MW25	To assess ambient target analyte concentrations in groundwater upgradient of FBH and both upgradient and downgradient of the East Landfill.
Surface-water sampling	VOCs, SVOCs, pesticides/PCBs, total and dissolved metals, ammonia, and nitrate	Fourteen samples from various creeks throughout FBH	To assess potential point and nonpoint sources basewide.
Sediment sampling	VOCs, SVOCs, pesticides/PCBs, total and dissolved metals, and nitrate	Eighteen samples from creeks, lakes, and ponds throughout FBH	To assess potential point and nonpoint sources basewide.
Land survey	-	Seven new and 10 existing monitoring wells	To assess monitoring well coordinates and elevations.

Table 3.6 (continued)

-	Not applicable
bgs	Below ground surface
FBH	Fort Benjamin Harrison
PCBs	Polychlorinated biphenyls
SVOCs	Semivolatile organic compounds
VOCs	Volatile organic compounds

Table 3.7: Fort Benjamin Harrison Environmental Investigation Laboratory and Field Analytical Methods

Analyte	USAEC Method Numbers		Reference Analytical Method	Method Approval Required	Associated EPA Sample Preparation Methods		EPA Sample Cleanup Method	
	Soil	Water			Soil[a]	Water[a]	Soil[a]	Water[a]
Volatile organic compounds (VOCs)	VMS1-SO and VMS2-SO	VMS1-WA and VMS2-WA	8240[a]	Yes	8240	8240	---	---
Semivolatile organic compounds (SVOCs)	SMV1-SO	SMV1-WA	8270[a]	Yes	3540	3510	3640	3640
Dioxins/furans	---	---	8290[a]	No	8290	8290	8290	8290
Pesticides/polychlorinated biphenyls (PCBs)	PST1-SO	PST1-WA	8080[a]	Yes	3540	3510	3640	3640
Herbicides	HBG1-SO	HBG1-WA	8150[a]	Yes	8150	8150	8150	8150
Phenols	---	---	8040[a]	Yes	3540	3510	3650	3650
Cyanide	CYN1-SO	CYN1-WA	9012[a]	Yes	---	---	---	---
Metals	ICP1-SO	ICP1-WA	6010[a]	Yes	3050	3005	---	---
Antimony	---	GSB1-WA	7041[a]	Yes	3050	3005	---	---
Arsenic	GAS1-SO	GAS1-WA	7060[a]	Yes	3050	7060	---	---
Lead	GPB1-SO	GPB1-WA	7421[a]	Yes	3050	3005	---	---
Mercury	---	HGC1-WA	7470[a,c]	Yes	---	7470	---	---
Mercury	HGC1-SO	---	7471[a,d]	Yes	7471	---	---	---
Selenium	GSE1-SO	GSE1-WA	7740[a]	Yes	3050	7740	---	---
Thallium	GTL1-SO	GTL1-WA	7841[a]	Yes	3050	3005	---	---
Total petroleum hydrocarbons (TPH)	TPH1-SO	TPH1-WA	Modified 8015	Yes	---	---	---	---
Landfill Parameters								
Alkalinity	---	---	310.1[b]	No	---	---	---	---
Ammonia	ANA1-SO	---	350.1[b]	Yes	---	---	---	---
Biochemical oxygen demand (BOD)	---	---	405.1[b]	No	---	---	---	---
Boron	---	---	6010[a]	Yes	---	---	---	---
Chemical oxygen demand (COD)	---	---	410.4[b]	No	---	---	---	---

Table 3.7 (continued)

Analyte	USAEC Method Numbers		Reference Analytical Method	Method Approval Required	Associated EPA Sample Preparation Methods		EPA Sample Cleanup Method	
	Soil	Water			Soil[a]	Water[a]	Soil[a]	Water[a]
Chloride	ANI1-SO	ANI1-WA	300.0[b]	Yes	---	---	---	---
Fluoride	ANI1-SO	ANI1-WA	300.0[b]	Yes	---	---	---	---
Hardness	---	---	130.2[b]	No	---	---	---	---
Nitrate	ANA2-SO	ANA2-WA	353.2[b]	Yes	---	---	---	---
pH	---	---	150.1[b,c]	No	---	---	---	---
pH	---	---	9045[b,d]		---	---	---	---
Specific conductivity	---	---	120.1[b]	No	---	---	---	---
Sulfate	ANI1-SO	ANI1-WA	300.0[b]	Yes	---	---	---	---
Total dissolved solids (TDS)	---	---	160.1[b]	No	---	---	---	---
Total organic carbon (TOC)	---	---	9060[b,d]	No	---	---	---	---
Total organic carbon (TOC)	---	---	415.1[b,c]	No	---	---	---	---
Total phenolic compounds	TPT1-SO	TPT1-WA	9066[a]	No	---	---	---	---
Field Analyses								
Organic vapor analysis	---	---	Manufacturer's instructions for HNU Model PI-101 or equivalent instrument	No	---	---	---	---
Water-level measurement	---	---	Manufacturer's instructions for Solinst sounder or equivalent	No	---	---	---	---
pH	---	---	Manufacturer's instructions for Beckman Model 021 or equilavent	No	---	---	---	---

Table 3.7 (continued)

Analyte	USAEC Method Numbers		Reference Analytical Method	Method Approval Required	Associated EPA Sample Preparation Methods		EPA Sample Cleanup Method	
	Soil	Water			Soil[a]	Water[a]	Soil[a]	Water[a]
Specific conductivity	---	---	Manufacturer's instructions for YSI Model 33-S-C-T or equilavent	No	---	---	---	---
Water temperature	---	---	Manufacturer's instructions	No	---	---	---	---
Soil gas	---	---	Tracer Research Corporation standard operating procedure (Appendix A)	No	---	---	---	---
Polychlorinated biphenyl screening	---	---	EnSys PCB RISc® manufacturer's instructions	No	---	---	---	---

--- Method not specified
EPA U.S. Environmental Protection Agency
RCRA Resource Conservation and Recovery Act
USAEC U.S. Army Environmental Center

a. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, U.S. EPA, SW-846, Third Edition, 1986.
b. Methods of Chemical Analysis of Water and Wastes, U.S. EPA, 1983.
c. Aqueous method
d. Soil/sediment

Table 3.8: Volatile Organic Compounds for Water and Soil Sample Analyses by SW-846 Method 8240 (USAEC Methods VMS-1 and VMS-2)

Target Analyte	Reporting Limit* Water (μg/l)	Soil (μg/g)
1-Chloro-2,3-epoxypropene	NA	NA
1,1-Dichloroethane	2	0.010
1,1-Dichloroethene	2	0.010
1,1,1-Trichloroethane	2	0.010
1,1,2-Trichloroethane	2	0.010
1,1,2,2-Tetrachloroethane	2	0.010
1,2-Dichloroethane	2	0.010
1,2-Dichloroethene, total	2	0.010
1,2-Dichloropropane	2	0.010
2-Butanone (MEK)	10	0.010
2-Chloroethylvinyl ether	10	0.010
2-Hexanone	10	0.010
4-Methyl-2-pentanone	10	0.010
Acetone	10	0.010
Acetonitrile	NA	NA
Benzene	2	0.010
Bromodichloromethane	2	0.010
Bromoform	2	0.010
Bromomethane	2	0.010
Carbon disulfide	10	0.010
Carbon tetrachloride	2	0.010
Chlorobenzene	2	0.010
Chloroethane	10	0.010
Chloroform	2	0.010
Chloromethane	2	0.010
cis-1,3-Dichloropropene	2	0.010
Dibromochloromethane	2	0.010
Dichlorodifluoromethane	NA	NA
Dioxane	NA	NA
Ethylbenzene	2	0.010
Ethyl methacrylate	NA	NA
Isobutyl alcohol	NA	NA
Methyl methacrylate	NA	NA
Ethylene oxide	NA	0.010
Methylene chloride	10	0.010
Styrene	2	0.010
Tetrachloroethene	2	0.010
Toluene	2	0.010
trans-1,3-Dichloropropene	2	0.010
Trichloroethene	2	0.010
Trichlorofluoromethane	NA	NA
Vinyl chloride	2	0.010
Vinyl acetate	10	0.010
Xylenes (total)	10	0.010

Table 3.8 (continued)

NA	A library search will be performed for the qualitative evaluation of samples for these compounds. No reporting limits have been established.
USAEC	U.S. Army Environmental Center
$\mu g/l$	Micrograms per liter
$\mu g/g$	Micrograms per gram

* Source: Environmental Science & Engineering, Inc.

Table 3.9: Semivolatile Organic Compounds for Water and Soil Sample Analyses by SW-846 Method 8270A (USAEC Method SMV1)

Target Analyte	Reporting Limits* Water (μg/l)	Soil (μg/g)
1,2-Dichlorobenzene	2.0	0.14
1,2,4-Trichlorobenzene	2.0	0.14
1,3-Dichlorobenzene	2.0	0.14
1,4-Dichlorobenzene	2.0	0.14
1,4-Naphthoquinone	NA	NA
2-Chloronaphthalene	2.0	0.14
2-Chlorophenol	2.0	0.14
2-Methylnaphthalene	2.0	0.14
2-Methylphenol	2.0	0.14
2-Nitroaniline	10	0.67
2-Nitrophenol	2.0	0.14
2,2′-Oxybis(1-chloropropane)	2.0	0.14
2,4-Dichlorophenol	2.0	0.14
2,4-Dimethylphenol	2.0	0.14
2,4-Dinitrophenol	30	1.35
2,4-Dinitrotoluene	2.0	0.14
2,4,5-Trichlorophenol	2.0	0.30
2,4,6-Trichlorophenol	2.0	0.30
2,6-Dinitrotoluene	2.0	0.14
3-Nitroaniline	10	0.67
3,3′-Dichlorobenzidine	10	0.67
4-Bromophenyl-phenylether	2.0	0.14
4-Chloro-3-methylphenol	2.0	0.14
4-Chloroaniline	2.0	0.30
4-Chlorophenyl-phenylether	2.0	0.14
4-Methylphenol	2.0	0.14
4-Nitroaniline	10	0.67
4-Nitrophenol	20	1.35
4,6-Dinitro-2-methylphenol	20	1.35
Acenaphthene	2.0	0.14
Acenaphthylene	2.0	0.14
Anthracene	2.0	0.14
Benzo(a)anthracene	2.0	0.14
Benzo(a)pyrene	2.0	0.14
Benzo(b)fluoranthene	2.0	0.14
Benzo(g,h,i)perylene	2.0	0.16
Benzo(k)fluoranthene	2.0	0.14
Benzoic acid	20	1.35
Benzyl alcohol	NA	NA
bis(2-Chloroethoxy)methane	2.0	0.14
bis(2-Chloroethyl) ether	2.0	0.14
bis(2-Chloroisopropyl)ether	NA	NA
bis(2-Ethylhexyl)phthalate	2.0	0.14
Butylbenzylphthalate	2.0	0.14

Table 3.9 (continued)

Target Analyte	Reporting Limits* Water (µg/l)	Soil (µg/g)
Carbazole	2.0	0.14
Chrysene	2.0	0.14
Di-N-butylphthalate	2.0	0.14
Di-N-octylphthalate	2.0	0.14
Dibenzo(a,h)anthracene	2.0	0.16
Dibenzofuran	2.0	0.14
Diethylphthalate	2.0	0.14
Dimethoate	NA	NA
Dimethylphthalate	2.0	0.14
Fluoranthene	2.0	0.14
Fluorene	2.0	0.14
Hexachlorobenzene	2.0	0.14
Hexachlorobutadiene	2.0	0.14
Hexachlorocyclopentadiene	10	1.0
Hexachloroethane	2.0	0.14
Indeno(1,2,3-c,d)pyrene	2.0	0.16
Isophorone	2.0	0.14
Isopropyl alcohol	NA	NA
N-Nitroso-di-n-propylamine	2.0	0.14
N-Nitrosodiphenylamine	2.0	0.14
Naphthalene	2.0	0.14
Nitrobenzene	2.0	0.14
Pentachlorophenol	10	0.67
Phenanthrene	2.0	0.14
Phenol	2.0	0.14
Pyrene	2.0	0.14
Thiophenol (benzenethiol)	NA	NA
tris(2,3-Dibromopropyl) phosphate	NA	NA

NA — A library search will be performed for the qualitative evaluation of samples for these compounds. No reporting limits have been established.
USAEC — U.S. Army Environmental Center
µg/g — Micrograms per gram
µg/l — Micrograms per liter

* Source: Environmental Science & Engineering, Inc.

Table 3.10: Pesticides and Polychlorinated Biphenyls for Water and Soil Sample Analyses by SW-846 Method 8080 (USAEC Method PST1)

	Reporting Limits#	
Target Analyte	Water (μg/l)	Soil (μg/g)
4,4'-DDD	0.005	0.003
4,4'-DDE	0.007	0.003
4,4'-DDT	0.007	0.003
Aldrin	0.005	0.003
alpha-BHC	0.005	0.003
alpha-Chlordane	0.005	0.003
Aroclor 1016	0.13	0.013
Aroclor 1242	0.13	0.013
Aroclor 1221	0.13	0.013
Aroclor 1232	0.13	0.013
Aroclor 1248	0.13	0.013
Aroclor 1254	0.13	0.013
Aroclor 1260	0.13	0.013
beta-BHC	0.005	0.003
delta-BHC	0.005	0.003
Dieldrin	0.005	0.003
Dimethoate*	0.25	0.033
Endosulfan I	0.005	0.003
Endosulfan II	0.005	0.003
Endosulfan sulfate	0.005	0.003
Endrin	0.005	0.003
Endrin aldehyde	0.02	0.022
gamma-BHC (Lindane)	0.005	0.003
gamma-Chlordane	0.005	0.003
Heptachlor	0.005	0.003
Heptachlor expoxide	0.005	0.003
Methoxychlor	0.009	0.003
Toxaphene	0.60	0.3
Endrin ketone	0.006	0.003
Chlordane	0.03	0.02

USAEC U.S. Army Environmental Center
μg/g Micrograms per gram
μg/l Micrograms per liter

* Analysis by SW-846 Method 8141 (USAEC Method NPG1)
# Source: Environmental Science & Engineering, Inc.

Table 3.11: Herbicides for Water and Soil Sample Analyses by SW-846 Method 8150 (USAEC Method HBG1)

Herbicides	Reporting Limit* Water (μg/l)	Soil (μg/g)
2,4′-D	0.1	0.01
2,4′-DB	0.1	0.01
2,4,5-T	0.1	0.01
2,4,5-TP (Silvex)	0.1	0.01
Dalapon	0.1	0.01
Dicamba	0.1	0.01
Dichloroprop	0.1	0.01
Dinoseb	0.1	0.01
MCPA	3.0	0.2
MCPP	3.0	0.2

USAEC U.S. Army Environmental Center
μg/g Micrograms per gram
μg/l Micrograms per liter

* Source: Environmental Science & Engineering, Inc.

Table 3.12: Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans Analyses by SW-846 Method 8290

Compound	Detection Limits* Water (ppq)	Soil (ppt)
Polychlorinated dibenzo-p-dioxins		
Total heptachloro-dibenzo-p-dioxin (HpCDD)	25 to 50	2.5 to 5.0
Total hexachloro-dibenzo-p-dioxin (HxCDD)	25 to 50	2.5 to 5.0
Total octachloro-dibenzo-p-dioxin (OCDD)	50 to 100	5.0 to 10
Total pentachloro-dibenzo-p-dioxin (PeCDD)	25 to 50	2.5 to 5.0
Total tetrachloro-dibenzo-p-dioxin (TCDD)	5 to 10	0.5 to 1.0
Polychlorinated dibenzofurans		
Total heptachloro-dibenzo-p-furan (HpCDF)	25 to 50	2.5 to 5.0
Total hexachloro-dibenzo-p-furan (HxCDF)	25 to 50	2.5 to 5.0
Total octachloro-dibenzo-p-furan (OCDF)	50 to 100	5.0 to 10
Total pentachloro-dibenzo-p-furan (PeCDF)	25 to 50	2.5 to 5.0
Total tetrachloro-dibenzo-p-furan (TCDF)	5 to 10	0.5 to 1.0
Specific isomers		
1,2,3,4,6,7,8-HpCDD	25 to 50	2.5 to 5.0
1,2,3,4,6,7,8-HpCDF	25 to 50	2.5 to 5.0
1,2,3,4,7,8-HxCDD	25 to 50	2.5 to 5.0
1,2,3,4,7,8-HxCDF	25 to 50	2.5 to 5.0
1,2,3,4,7,8,9-HpCDF	25 to 50	2.5 to 5.0
1,2,3,6,7,8-HxCDD	25 to 50	2.5 to 5.0
1,2,3,6,7,8-HxCDF	25 to 50	2.5 to 5.0
1,2,3,7,8-PeCDD	25 to 50	2.5 to 5.0
1,2,3,7,8-PeCDF	25 to 50	2.5 to 5.0
1,2,3,7,8,9-HxCDD	25 to 50	2.5 to 5.0
1,2,3,7,8,9-HxCDF	25 to 50	2.5 to 5.0
2,3,4,6,7,8-HxCDF	25 to 50	2.5 to 5.0
2,3,4,7,8-PeCDF	25 to 50	2.5 to 5.0
2,3,7,8-TCDD	5 to 10	0.5 to 1.0
2,3,7,8-TCDF	5 to 10	0.5 to 1.0

ppq Parts per quadrillion (picograms per liter)
ppt Parts per trillion (nanograms per kilogram)

* The detection limit ranges are estimates. Actual detection limits for each congener will be sample specific and will be reported by the laboratory.

Table 3.13: Metals and Cyanide for Soil and Water Sample Analyses by SW-846 Method 6010 (USAEC Method ICP1)

Target Analyte	Reporting Limits[a] Water (μg/l)	Soil (μg/g)
Aluminum	40.0	10.0
Antimony[b]	3.0	5.0
Arsenic[c]	2.5	0.25
Barium	25.0	5.0
Beryllium	5.0	0.5
Cadmium	5.0	0.5
Calcium	100	20.0
Chromium	10.0	1.0
Cobalt	20.0	2.0
Copper	5.0	0.5
Cyanide[d]	2.5	0.25
Iron	45.0	10.0
Lead[e]	2.0	5.0
Magnesium	50.0	10.0
Manganese	5.0	0.5
Mercury[f]	0.2	0.1
Nickel	15.0	2.0
Potassium	550	60.0
Selenium[g]	2.5	0.25
Silver	5.0	0.50
Sodium	100	20.0
Thallium[h]	2.5	10.0
Vanadium	10.0	1.0
Zinc	20.0	5.0

USAEC U.S. Environmental Center
μg/g Micrograms per gram
μg/l Micrograms per liter

a. Source is Environmental Science & Engineering, Inc.
b. Antimony analytical method is SW-846 7041 for aqueous samples only (USAEC Method GSB1).
c. Arsenic analytical method is SW-846 7060 (USAEC Method GAS1).
d. Cyanide analytical method is SW-846 9012A (USAEC Method CYNI).
e. Lead analytical method is SW-846 7421 for aqueous samples only (USAEC Method GPB1).
f. Mercury analytical methods are SW-846 7470 and 7471 for aqueous and soil/sediment methods, respectively (USAEC Method HGC1).
g. Selenium analytical method is SW-846 7740.
h. Thallium analytical method is SW-846 7841 for aqueous samples only.

Table 3.14: Landfill Parameters and Total Petroleum Hydrocarbons Soil and Water Sample Analyses by U.S. Environmental Protection Agency Analytical Methods

Landfill Parameter	EPA Analytical Method	Reporting Limits[a] Water (μg/l)	Soil (μg/g)
Alkalinity (water only)	310.1[b]	5000 as $CaCO_3$	NA
Ammonia	350.1[b]	50 as N	6.25
Biochemical oxygen demand (water only)	405.1[b]	1000	NA
Boron	SW-846 6010[c]	50.0	5.0
Chemical oxygen demand (water only)	410.4[b]	3,000	NA
Chloride	300.0[b]	500	5.0
Fluoride	300.0[b]	500	2.5
Hardness (water only)	130.2[b]	1000 as $CaCO_3$	NA
Nitrate	353.2[b]	20	0.2
pH	150.1[b]	NA	NA
Specific conductivity (water only)	120.1[b]	NA	NA
Sulfate	300.0[b]	5000	25.0
Total phenolic compounds	SW-846 9066[c]	2.0	1.0
Total organic carbon	SW-846 9060[c]	1000	NA
Total dissolved solids (water only)	160.1[b]	10,000	NA
Total Petroleum Hydrocarbons	8015[c]		
Diesel		0.4	8
Gasoline		0.4	8

$CaCO_3$ Calcium carbonate
NA Information not available
μg/g Micrograms per gram
μg/l Micrograms per liter

a. Source is Environmental Science & Engineering, Inc.
b. U.S. Environmental Protection Agency 1983, Methods for Chemical Analysis of Water and Wastes, March.
c. U.S. Environmental Protection Agency 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods SW-846.

Table 3.15: Target Analytes for Analyses of Soil-Gas Samples

Compound	Quantitation Limit in Soil Gas# (μg/l)
Total volatile hydrocarbons*	
Benzene	0.03
Ethylbenzene	0.03
Total volatile hydrocarbons	0.03
Total xylenes	0.03
Toluene	0.03
Halogenated compounds	
1,1-Dichloroethane	0.02
1,1,1-Trichloroethane	0.0002
1,2-Dichlorethane	0.02
Chloroform	0.006
cis-1,2-Dichloroethene	0.02
Methylene chloride	0.1
Tetrachloroethene	0.0002
trans-1,2-Dichloroethene	0.02
Trichloroethene	0.0002
Vinyl chloride	0.2

RCRA Resource Conservation and Recovery Act
μg/l Micrograms per liter

* Total volatile hydrocarbon analyses will be performed at non-RCRA locations specified in the Technical Sampling Plan to quantify C_4 through C_9 hydrocarbons and benzene, toluene, ethylbenzene, and xylenes (BTEX). The C_4 through C_9 hydrocarbons will be quantified as a group using an average response factor from analysis of BTEX compounds.

\# Estimated quantitation limits. Actual quantitation limits achieved will be reported.

Table 3.16: Background Concentrations of Selected Target Analytes in Surface Soil, Crosby-Brookston Soil Association

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		15,600	
Antimony	LT	5	j/J
Arsenic		6.9	j
Barium		94.7	
Beryllium	LT	0.5	
Cadmium	LT	0.5	
Calcium		9990	
Chromium		19.5	
Cobalt		7.26	
Copper		20.8	
Cyanide	LT	0.25	
Iron		19,500	
Lead		32.4	
Magnesium		6230	
Manganese		338	
Mercury	LT	0.1	
Nickel		19.5	
Potassium		1690	
Selenium		0.486	
Silver	LT	0.5	
Sodium		387	
Thallium	LT	10	
Vanadium		33.7	
Zinc		69.2	

FC Flagging code
j Value is estimated, flag added during independent data validation
/J The low spike recovery is low; qualifier applied during Army data review
LT Less than the method detection limit
mg/kg Milligrams per kilogram

Table 3.17: Background Concentrations of Selected Target Analytes in Surface Soil, Genesee-Sloan Soil Association

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		13,300	
Antimony	LT	5	
Arsenic		7.3	j
Barium		87.6	
Beryllium	LT	0.5	
Cadmium	LT	0.5	
Calcium		4820	
Chromium		17.5	j
Cobalt		9.2	
Copper		20.4	
Cyanide	LT	0.25	
Iron		19,000	
Lead		24.8	
Magnesium		3070	
Manganese		774	
Mercury	LT	0.1	
Nickel		20.4	
Potassium		2340	
Selenium	LT	0.25	
Silver	LT	0.5	
Sodium		409	
Thallium	LT	10	
Vanadium		32.1	j
Zinc		81.8	

FC Flagging code
j Value is estimated, flag added during independent data validation
LT Less than the method detection limit
mg/kg Milligrams per kilogram

Table 3.18: Background Concentrations of Selected Target Analytes in Surface Soil, Miami-Crosby Soil Association

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		12,800	j
Antimony	LT	5	j/J
Arsenic		11	
Barium		95.5	
Beryllium		1.08	
Cadmium	LT	0.5	
Calcium		6020	
Chromium		17.2	
Cobalt		8.48	
Copper		22.5	
Cyanide	LT	0.25	
Iron		18,500	
Lead		40.9	
Magnesium		3960	
Manganese		924	
Mercury	LT	0.1	
Nickel		17.6	
Potassium		2500	
Selenium		0.542	j
Silver	LT	0.5	
Sodium		487	
Thallium	LT	10	
Vanadium		33.5	
Zinc		74.9	

FC	Flagging code
j	Value is estimated, flag added during independent data validation
/J	The low spike recovery is low; qualifier applied during Army data review
LT	Less than the method detection limit
mg/kg	Milligrams per kilogram

Table 3.19: Background Concentrations of Selected Target Analytes in Subsurface Soil, 1- to 2.5-Foot Depth Interval

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		22,000	
Antimony	LT	5	j
Arsenic		15	
Barium		112	
Beryllium		0.837	
Boron		18	
Cadmium	LT	0.5	
Calcium		110,000	
Chromium		29.6	j
Cobalt		10.9	
Copper		28.3	
Cyanide	LT	0.25	j
Iron		22,200	
Lead		20.9	
Magnesium		30,300	
Manganese		522	
Mercury	LT	0.1	
Nickel		28.9	
Potassium		788	D
Selenium	LT	0.25	rr
Silver	LT	0.5	
Sodium		404	
Thallium		22.4	
Vanadium		53	j
Zinc		83.7	
Chloride		8.57	
Fluoride		2.5	
Sulfate	LT	25	j
Total recoverable phenolics	LT	1	

D Duplicate sample analysis
FC Flagging code
j Value is estimated, flag added during independent data validation
LT Less than the method detection limit
mg/kg Milligrams per kilogram
rr Value was found to be unacceptable during independent data validation

Table 3.20: Background Concentrations of Selected Target Analytes in Subsurface Soil, 2.5- to 6.5-Foot Depth Interval

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		4380	
Antimony	LT	5	j
Arsenic		6.7	rr
Barium		78.1	
Beryllium		0.644	
Boron		19	
Cadmium	LT	0.5	
Calcium		104,000	
Chromium		26	j
Cobalt		6.82	
Copper		27.3	
Cyanide	LT	0.25	
Iron		22,300	
Lead		14.9	
Magnesium		31,300	
Manganese		369	
Mercury	LT	0.1	
Nickel		24.8	
Potassium		2230	
Selenium	LT	0.25	rr/NJ
Silver	LT	0.5	
Sodium		682	
Thallium		24.7	
Vanadium		45.8	j
Zinc		76.8	
Chloride	LT	5	j
Fluoride		2.94	
Sulfate	LT	25	
Total recoverable phenolics	LT	1	

FC — Flagging code
j — Value is estimated, flag added during independent data validation
LT — Less than the method detection limit
mg/kg — Milligrams per kilogram
/NJ — The high spike recovery is very low; qualifier applied during Army data review
rr — Value was found to be unacceptable during independent data validation

Table 3.21: Background Concentrations of Selected Target Analytes in Subsurface Soil, 6.5- to 9.5-Foot Depth Interval

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		5300	
Antimony	LT	5	j
Arsenic		6.8	D
Barium	LT	39.8	
Beryllium	LT	0.5	
Boron		15.5	
Cadmium	LT	0.5	
Calcium		110,000	
Chromium		9.32	
Cobalt		4.91	
Copper		12.4	D
Cyanide	LT	0.25	
Iron		10,500	D
Lead	LT	5	
Magnesium		74,400	
Manganese		346	
Mercury	LT	0.1	
Nickel		13.5	D
Potassium		1130	
Selenium	LT	0.25	rr
Silver	LT	0.5	
Sodium		488	
Thallium		22.3	
Vanadium		13.5	D
Zinc		38.3	D
Chloride	LT	5	
Fluoride	LT	2.5	
Sulfate		28.6	
Total recoverable phenolics	LT	1	

D Duplicate sample analysis
FC Flagging code
j Value is estimated, flag added during independent data validation
LT Less than the method detection limit
mg/kg Milligrams per kilogram
rr Value was found to be unacceptable during independent data validation

Table 3.22: Background Concentrations of Selected Target Analytes in Subsurface Soil, 11- to 12.5-Foot Depth Interval

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		2250	
Antimony	LT	5	j
Arsenic		9	
Barium	LT	39.8	
Beryllium	LT	0.5	
Boron		8.52	
Cadmium	LT	0.5	
Calcium		103,000	
Chromium		4.95	
Cobalt	LT	2	
Copper		9.79	
Cyanide	LT	0.25	
Iron		7420	
Lead	LT	5	
Magnesium		21,400	
Manganese		225	
Mercury	LT	0.1	
Nickel		8.55	
Potassium		506	
Selenium	LT	0.25	rr
Silver	LT	0.5	
Sodium		466	
Thallium	LT	10	
Vanadium		6.75	
Zinc		30.4	
Chloride	LT	5	
Fluoride	LT	2.5	
Sulfate	LT	25	
Total recoverable phenolics	LT	1	

FC Flagging code
j Value is estimated, flag added during independent data validation
LT Less than the method detection limit
mg/kg Milligrams per kilogram
rr Value was found to be unacceptable during independent data validation

Table 3.23: Background Concentrations of Selected Target Analytes in Subsurface Soil, 13.5- to 15.5-Foot Depth Interval

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		3440	
Antimony	LT	5	j
Arsenic		6.7	
Barium	LT	39.8	
Beryllium	LT	0.5	
Boron		7.76	
Cadmium	LT	0.5	
Calcium		94,200	
Chromium		5.99	
Cobalt		3.66	
Copper		13.3	
Cyanide	LT	0.25	
Iron		8760	
Lead	LT	5	
Magnesium		26,600	
Manganese		288	
Mercury	LT	0.1	
Nickel		10.9	
Potassium		710	
Selenium	LT	0.25	rr
Silver	LT	0.5	
Sodium		388	
Thallium		24.8	
Vanadium		8.54	
Zinc		39.9	
Chloride	LT	5	
Fluoride	LT	2.5	rr
Sulfate		64.3	
Total recoverable phenolics	LT	1	

FC Flagging code
j Value is estimated, flag added during independent data validation
LT Less than the method detection limit
mg/kg Milligrams per kilogram
rr Value was found to be unacceptable during independent data validation

Table 3.24: Background Concentrations of Selected Target Analytes in Subsurface Soil, 18.5-Foot Depth

Analyte	Boolean	Background (mg/kg)	FC
Aluminum		4570	
Antimony	LT	5	j
Arsenic		4.5	
Barium	LT	39.8	
Beryllium	LT	0.5	
Boron		13.4	
Cadmium	LT	0.5	
Calcium		110,000	
Chromium		6.57	
Cobalt		3.23	
Copper		10.7	
Cyanide	LT	0.25	
Iron		8240	
Lead	LT	5	
Magnesium		25,600	
Manganese		267	
Mercury	LT	0.1	
Nickel		10.6	
Potassium		1010	
Selenium	LT	0.25	rr
Silver	LT	0.5	
Sodium		445	
Thallium	LT	10	
Vanadium		10.4	
Zinc		31.2	
Chloride	LT	5	
Fluoride	LT	2.5	
Sulfate		138	
Total recoverable phenolics	LT	1	

FC — Flagging code
j — Value is estimated, flag added during independent data validation
LT — Less than the method detection limit
mg/kg — Milligrams per kilogram
rr — Value was found to be unacceptable during independent data validation

Table 3.25: Background Concentrations of Selected Target Analytes in Groundwater

Analyte	Boolean	Background ($\mu g/l$)	FC
Aluminum		4290	
Aluminum (filtered)	LT	40	F
Antimony	LT	3	
Antimony (filtered)	LT	3	F
Arsenic		4.7	
Arsenic (filtered)	LT	2.5	F
Barium		143	
Barium (filtered)		113	F
Beryllium	LT	5	
Beryllium (filtered)	LT	5	F
Boron		68.9	
Cadmium	LT	5	
Cadmium (filtered)	LT	5	F
Calcium		127,000	
Calcium (filtered)		102,000	F
Chromium		10.7	
Chromium (filtered)	LT	10	F
Cobalt	LT	20	
Cobalt (filtered)	LT	20	F
Copper		7.22	
Copper (filtered)	LT	5	F
Cyanide	LT	2.5	
Iron		6640	
Iron (filtered)		67.7	F
Lead		2	bj
Lead (filtered)	LT	2	Fj
Magnesium		45,800	
Magnesium (filtered)		38,300	F
Manganese		305	
Manganese (filtered)		193	F
Mercury	LT	0.2	
Mercury (filtered)	LT	0.2	F
Nickel	LT	15	
Nickel (filtered)	LT	15	F
Potassium		3410	
Potassium (filtered)		1720	F
Selenium	LT	2.5	j
Selenium (filtered)	LT	2.5	Fj
Silver	LT	5	
Silver (filtered)	LT	5	F
Sodium		22,000	
Sodium (filtered)		21,800	F
Thallium	LT	2.5	j
Thallium (filtered)	LT	2.5	Fj
Vanadium	LT	10	
Vanadium (filtered)	LT	10	F

Table 3.25 (continued)

Analyte	Boolean	Background (μg/l)	FC
Zinc		30.2	
Zinc (filtered)	LT	20	F
Alkalinity		390,000	j
Biological oxygen demand		2000	j
Chemical oxygen demand	LT	5000	j
Chloride		40,000	
Fluoride	LT	500	
Sulfate		58,000	
Total dissolved solids		510,000	j
Total recoverable phenolics	LT	2	

---

b	Flag applied during data validation to indicate the compound was detected in the associated method blank.
F	Sample was filtered prior to analysis
FC	Flagging code
j	Value is estimated, flag added during independent data validation
LT	Less than the method detection limit
μg/l	Milligrams per liter

Table 3.26: Federal Maximum Contaminant Levels

Primary MCLs Contaminant	MCL (mg/l)
1,1-Dichloroethene	0.007
1,1,1-Trichloroethane	0.2
1,1,2-Trichloroethane	0.005
1,2-Dichloroethane	0.005
1,2-Dichloropropane	0.005
1,2,4-Trichlorobenzene	0.07
Benzene	0.005
Carbon tetrachloride	0.005
cis-1,2-Dichloroethene	0.07
Dichloromethane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
o-Dichlorobenzene	0.6
para-Dichlorobenzene	0.075
Styrene	0.1
Tetrachloroethene	0.005
Toluene	1
trans-1,2-Dichloroethene	0.1
Trichloroethene	0.005
Trihalomethanes (total)	0.1
Vinyl chloride	0.002
Xylenes (total)	10
2,4-D	0.07
2,4,5-TP	0.05
Alachlor	0.002
Aldicarb sulfone	0.003
Aldicarb sulfoxide	0.004
Aldicarb	0.003
Atrazine	0.003
Carbofuran	0.04
Chlordane	0.002
Dibromochloropropane	0.0002
Endrin	0.002
Ethylene dibromide	0.00005
Heptachlor	0.0004
Heptachlor epoxide	0.0002
Lindane	0.0002
Methoxychlor	0.04
Pentachlorophenol	0.001
Polychlorinated biphenyls	0.0005
Toxaphene	0.003

Primary MCLs Contaminant	MCL (mg/l)
2,3,7,8-TCDD (Dioxin)	3×10^{-8}
Benzo[a]pyrene	0.0002
Dalapon	0.2
Di(2-ethylhexyl) adipate	0.4
Di(2-ethylhexyl) phthalate	0.006
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Glyphosate	0.7
Hexachlorbenzene	0.001
Hexachlorocyclopentadiene	0.05
Oxamyl (vydate)	0.2
Picloram	0.5
Simazine	0.004
Antimony	0.006
Arsenic	0.05
Asbestos	7 million fibers/liter (longer than 10 μm)
Barium	2
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Copper	1.3*
Cyanide (as free cyanide)	0.2
Fluoride	4
Lead	0.015*
Mercury	0.002
Nickel	0.1
Nitrate	10 (as nitrogen)
Nitrite	1 (as nitrogen)
Selenium	0.05
Thallium	0.002
Total nitrate and nitrite	10 (as nitrogen)

Table 3.26 (continued)

Secondary MCLs Contaminant	MCL (mg/l)
Aluminum	0.05 to 0.2 mg/l
Chloride	250 mg/l
Color	15 color units
Copper	1.0 mg/l
Corrosivity	Noncorrosive
Fluoride	2.0 mg/l
Foaming agents	0.5 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Odor	3 threshold odor numbers
pH	6.5-8.5
Silver	0.1 mg/l
Sulfate	250 mg/l
Total dissolved solids (TDS)	500 mg/l
Zinc	5 mg/l

MCL Maximum contaminant level
mg/l Milligrams per liter

* Action level

Table 3.27: Federal Ambient Water Quality Criteria for Analytes Detected in Fort Benjamin Harrison Surface-Water Samples

Analyte	AWQC Freshwater Acute	AWQC Freshwater Chronic
2,4-D/2,4-Dichlorophenoxyaceticacid	---	---
Antimony	9000*	1600*
Arsenic (V)	850*	48*
Arsenic (III)	360	190
Barium	---	---
Cadmium	3.9#	1.1
Chromium (III)	1700#	210#
Copper	18#	12#
Iron	---	1000
Lead	82#	3.2#
Manganese	---	---
Mercury	2.4	0.012
Nickel	1400#	160#
Zinc	120#	110#

Units are micrograms per liter.
Source: EPA, 1986, updated May 1, 1987.

AWQC Ambient Water Quality Criteria
--- Ambient Water Quality Criteria not established

* Insufficient data to develop criteria. Value presented is the lowest observed effect level (LOEL)
\# Hardness dependent criteria (100 milligrams per liter calcium carbonate [$CaCO_2$] used)

Table 3.28: Water-Level Elevations (February 14, 1994)

Well ID	Stick-Up (feet)	Elev. T.O.C. (feet M.S.L.)	Elev. G.S. (feet M.S.L.)	Water Depth (feet T.O.C.)	Water Depth (feet B.G.S.)	Water Elev. (feet M.S.L.)
MW01	1.82	849.34	847.52	18.48	16.66	830.86
MW02	3.44	828.66	825.22	*	*	*
MW03	3.03	836.05	833.02	29.92	26.89	806.13
MW04	3.08	844.85	841.77	44.74	41.66	800.11
MW05	2.67	841.55	838.88	9.76	7.09	831.79
MW06	2.36	864.06	861.70	9.80	7.44	854.26
MW07	1.51	864.75	863.24	9.14	7.63	855.61
MW08	2.09	866.86	864.77	*	*	*
MW09	1.48	865.85	864.37	5.88	4.40	859.97
MW10	1.70	865.53	863.83	10.40	8.70	855.13
MW11	1.42	865.11	863.69	3.73	2.31	861.38
MW12	1.00	774.96	773.96	31.43	30.43	743.53
MW13	2.10	755.23	753.13	14.53	12.43	740.70
MW14	1.58	753.45	751.87	12.86	11.28	740.59
MW15	1.70	754.17	752.47	13.43	11.73	740.74
MW16	1.05	841.92	840.87	2.87	1.82	839.05
MW17	1.59	847.09	845.50	3.91	2.32	843.18
MW18	-0.20	845.28	845.48	4.32	4.52	840.96
MW19	0.00	835.59	835.59	9.69	9.69	825.90
MW20	2.20	845.96	843.76	5.25	3.05	840.71
MW21	1.33	846.68	845.35	2.97	1.64	843.71
MW22	1.24	849.08	847.84	4.09	2.85	844.99
MW23	1.35	849.50	848.15	3.13	1.78	846.37
MW24	1.22	850.44	849.22	5.93	4.71	844.51
MW25	1.36	843.56	842.20	4.10	2.74	839.46
EI001MW001	1.85	856.96	855.11	5.93	4.08	851.03
EI001MW002	-0.40	851.99	852.39	3.69	4.09	848.30
EI001MW003	1.67	852.19	850.52	5.41	3.74	846.78
EI001MW004	-0.50	852.00	852.50	2.68	3.18	849.32
EI002MW001	-0.42	856.60	857.02	3.12	3.54	853.48
EI002MW002	-0.34	856.98	857.32	6.38	6.72	850.60
EI002MW003	-0.21	856.82	857.03	19.50	19.71	837.32
EI002MW004	-0.26	855.93	856.19	4.71	4.97	851.22
EI003MW001	2.10	843.45	841.35	6.11	4.01	837.34
EI003MW002	1.59	843.53	841.94	6.85	5.26	836.68
EI003MW003	-0.32	853.42	853.74	7.59	7.91	845.83
EI003MW004	1.86	853.76	851.90	14.86	13.00	838.90
EI004MW001	2.17	859.15	856.98	15.22	13.05	843.93
EI004MW002	2.33	861.54	859.21	17.74	15.41	843.80
EI004MW003	2.25	861.16	858.91	13.21	10.96	847.95
EI004MW004	-0.36	858.58	858.94	13.80	14.16	844.78
SM008MW001	2.33	867.63	865.30	6.99	4.66	860.64
SM008MW002	2.33	865.92	863.59	6.25	3.92	859.67
SM008MW003	2.30	866.61	864.31	5.81	3.51	860.80
SM008MW004	1.50	867.54	866.04	6.25	4.75	861.29
SM011MW001	2.25	754.51	752.26	13.99	11.74	740.52
SMBKGMW001	1.80	869.94	868.14	7.53	5.73	862.41
SMBKGMW002	1.79	869.33	867.54	7.08	5.29	862.25
SMBKGMW003	1.80	865.20	863.40	4.08	2.28	861.12

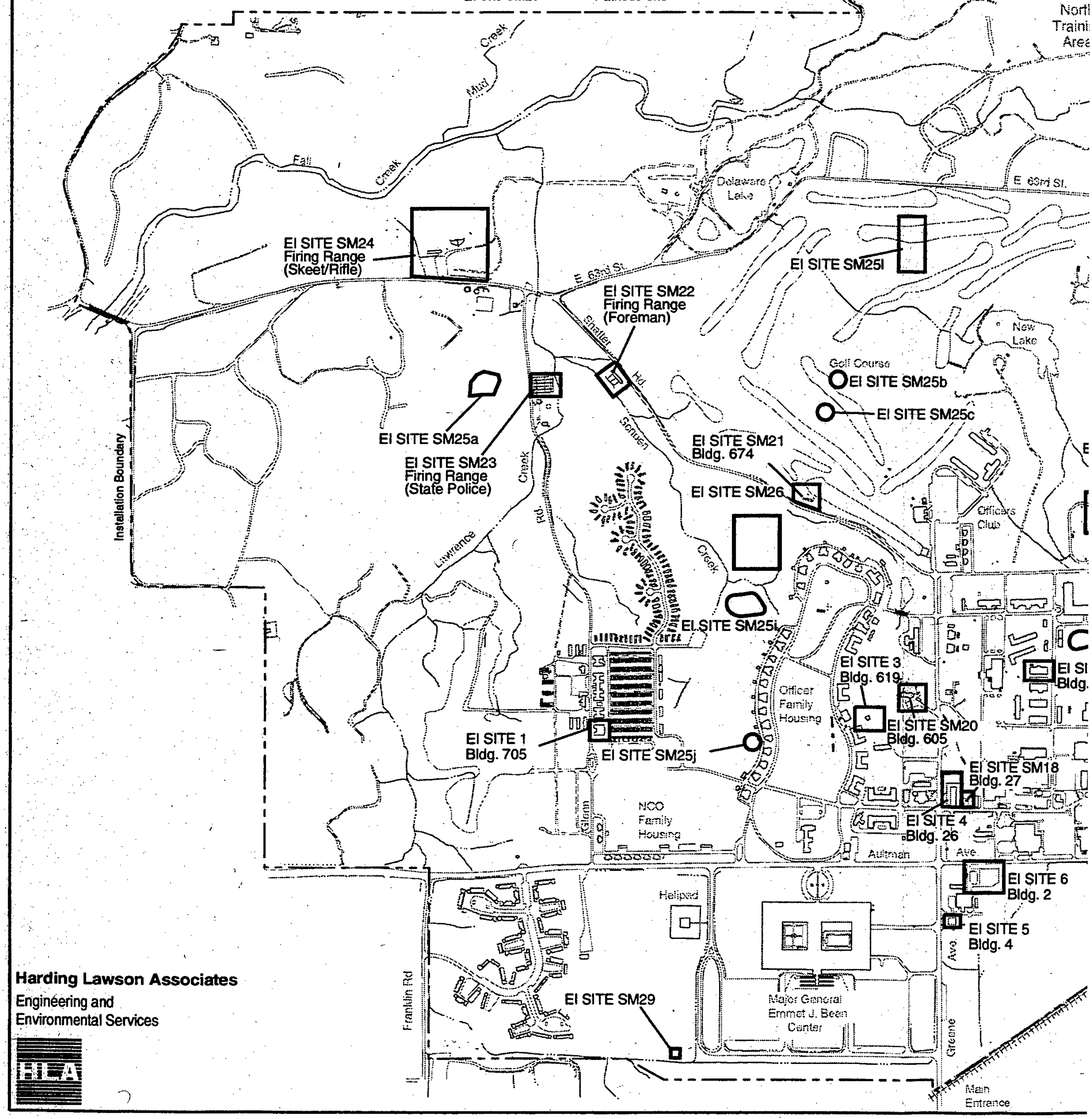
Table 3.28 (continued)

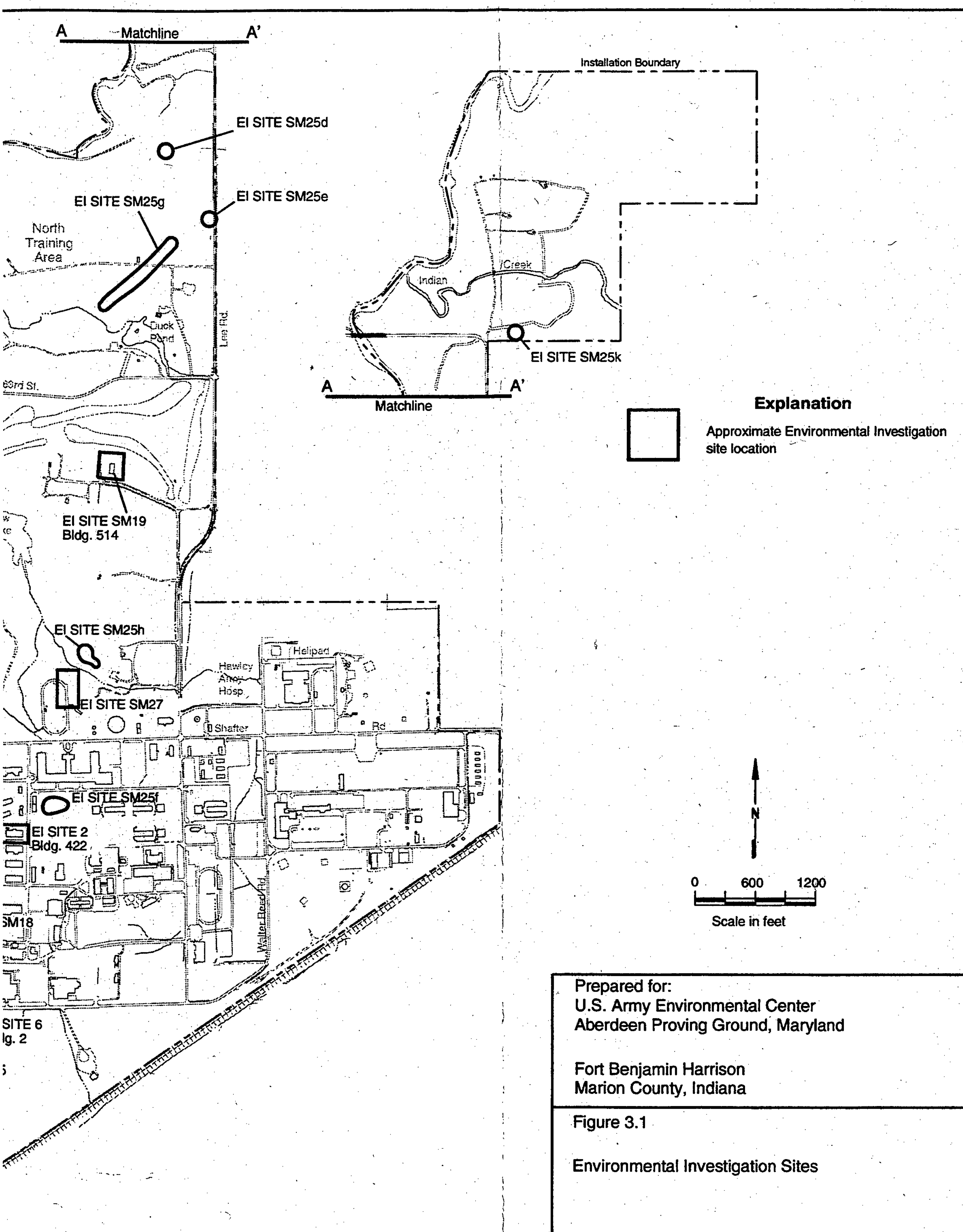
Well ID	Stick-Up (feet)	Elev. T.O.C. (feet M.S.L.)	Elev. G.S. (feet M.S.L.)	Water Depth (feet T.O.C.)	Water Depth (feet B.G.S.)	Water Elev. (feet M.S.L.)
SMBKGMW004	1.80	863.31	861.51	3.47	1.67	859.84
SMBKGMW005	2.33	857.84	855.51	5.31	2.98	852.53
SMBKGMW006	1.85	840.81	838.96	5.12	3.27	835.69
SMBKGMW007	1.88	849.93	848.05	4.10	2.22	845.83

* Not measured

BENJ/21574003 9/12/95 LDZ

EI Site 1	Auto Craft Shop, Building 705
EI Site 2	Roads and Grounds Vehicle Maintenence Shop, Building 422
EI Site 3	Former PX Gas Station, Building 619
EI Site 4	DIS Engineering/Maintenance, Building 26
EI Site 5	Electrical Shop, Building 4
EI Site 6	Former Coal Storage Yard, Building 2
EI Site SM18	DIS Maintenance Storage Shed, Building 27
EI Site SM19	Pesticide Mixing and Storage Area, Building 514
EI Site SM20	DIS Entomology, Building 605
EI Site SM21	Golf Course Pesticide Mixing and Storage Area, Building 674
EI Site SM22	Foreman Rifle Range, Near Buildings 811 and 812
EI Site SM23	State Police Range, Near Building 815
EI Site SM24	Skeet/Rifle Range, Near Buildings 819 through 822
EI Site SM25	Historic Military Sites, 11 Locations Basewide
EI Site SM26	Former Sewage Treatment Plant, West of Building 674
EI Site SM27	Former Sewage Treatment Plant, North of Building 509
EI Site SM28	Wash Racks, Grease Racks, and O/W Separators, Various Locations Basewide (not shown)
EI Site SM29	Patriotic Site





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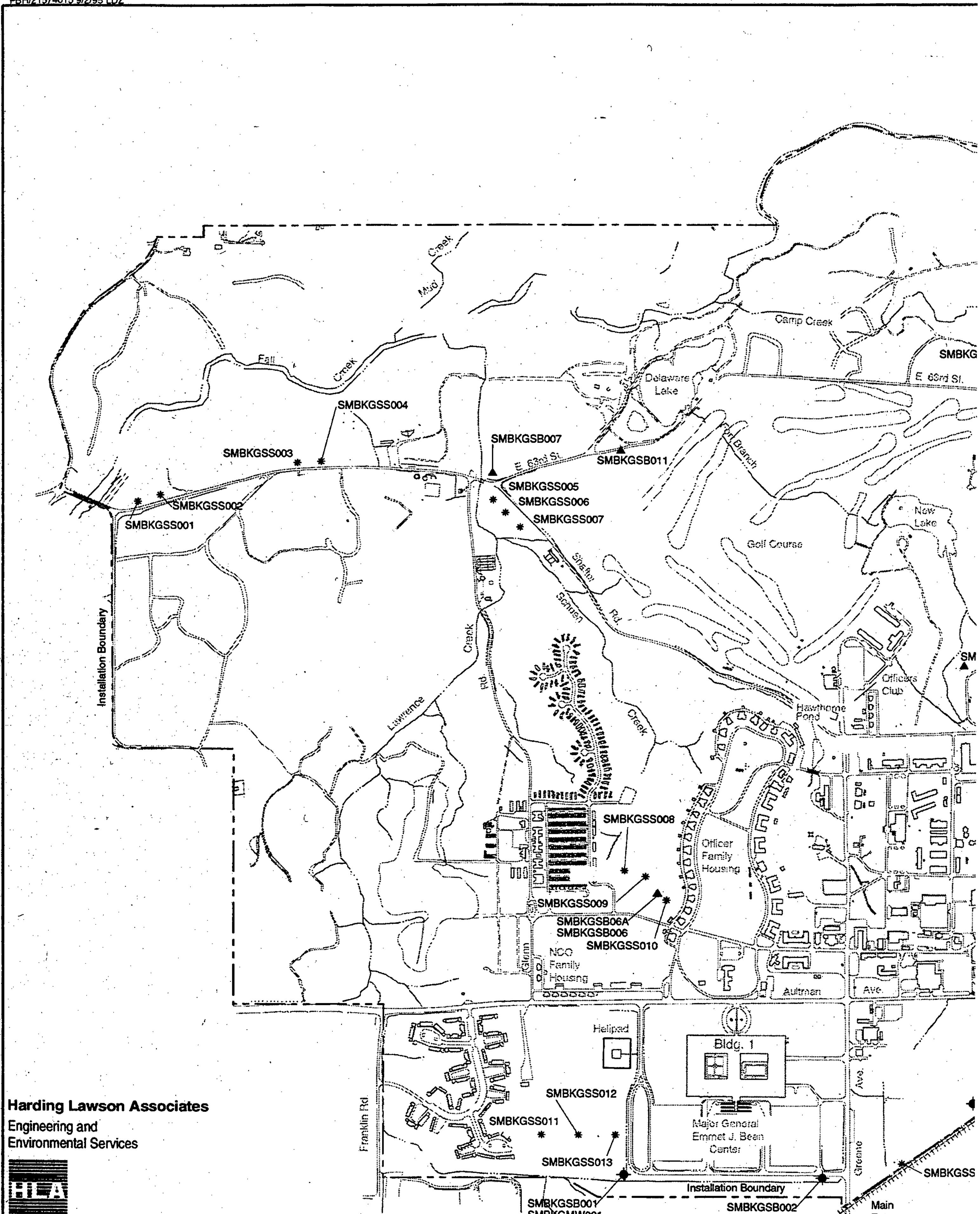
Marion County, Indiana

Figure 3.1

Environmental Investigation Sites



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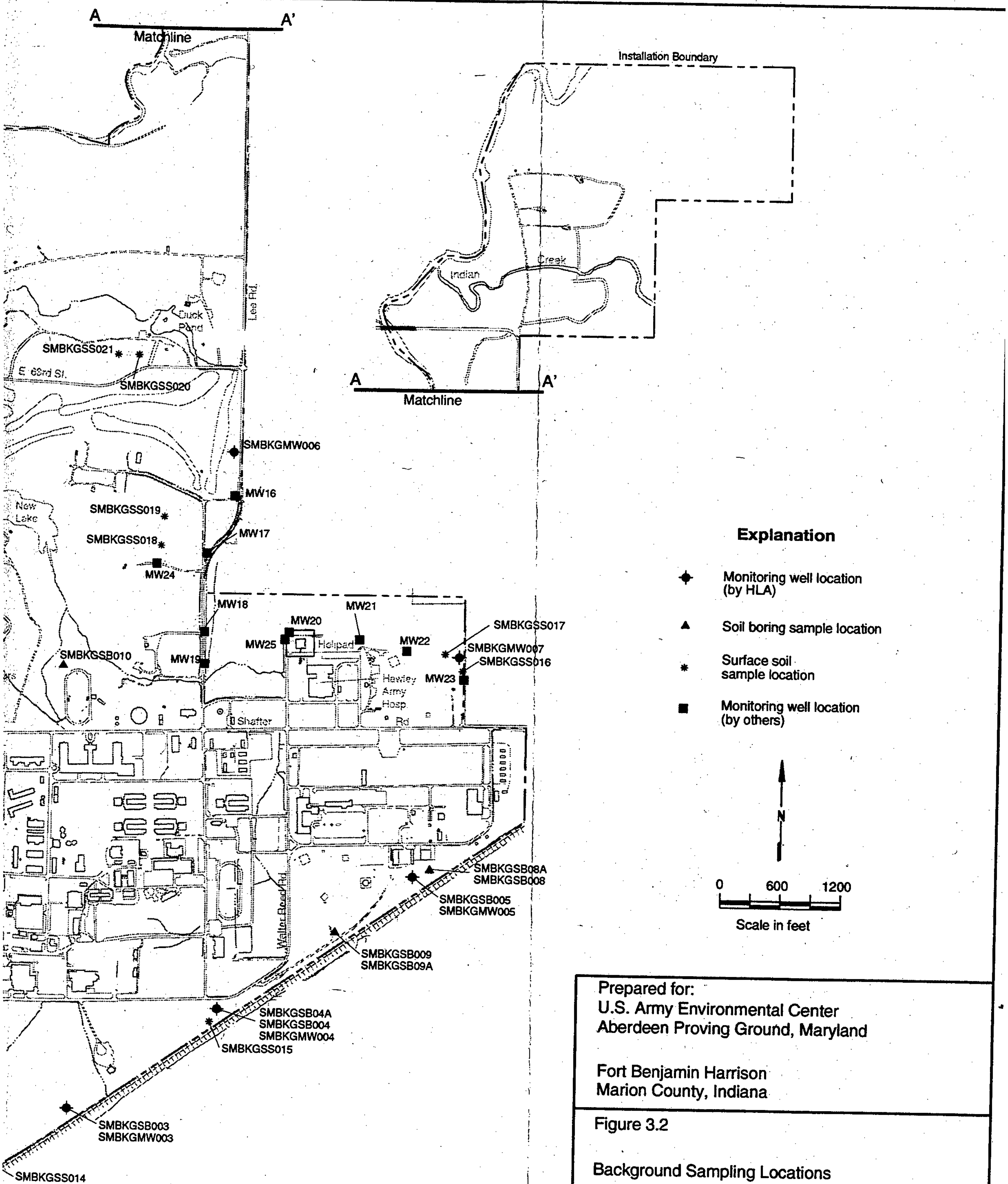

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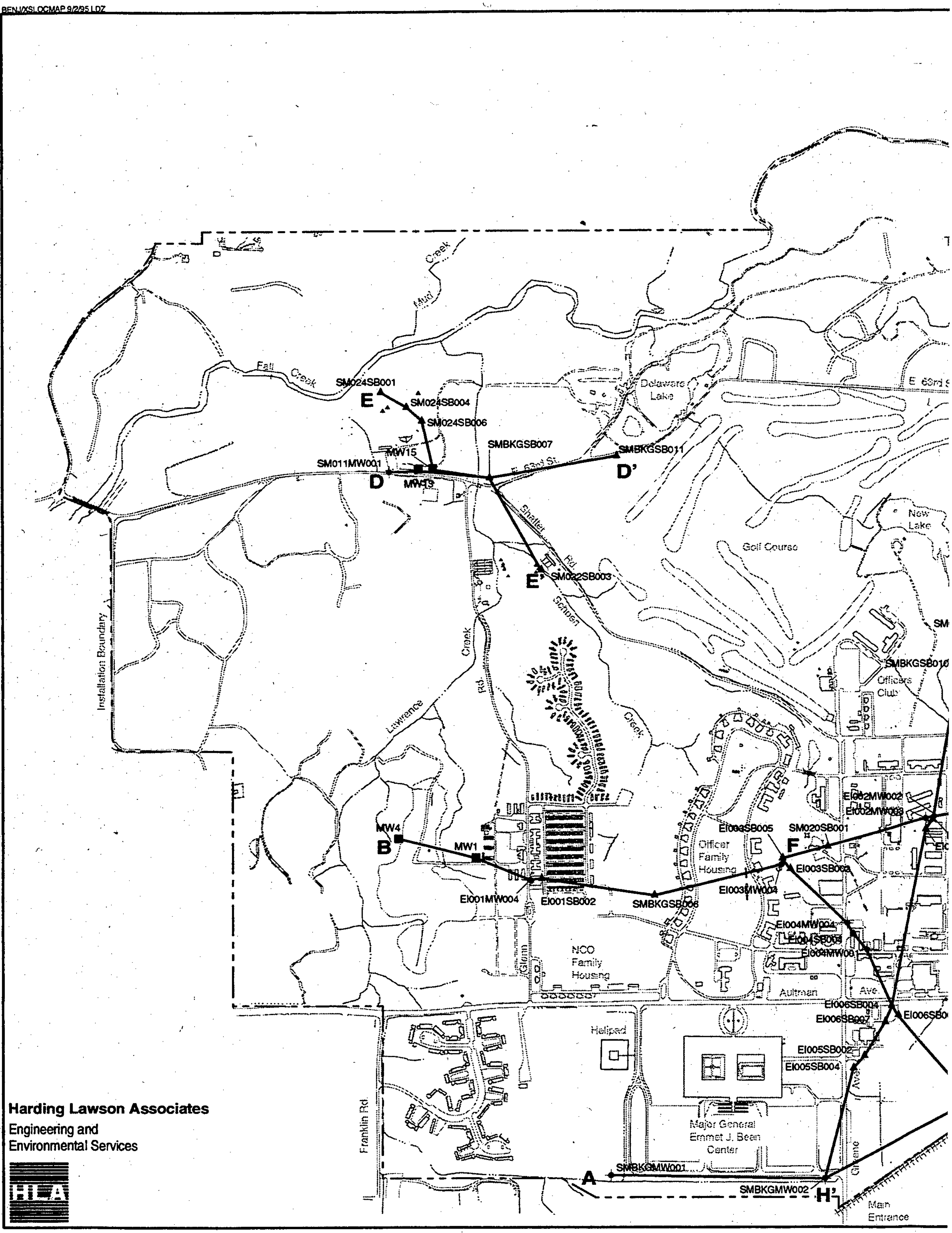
Figure 3.2

Background Sampling Locations

BENJ/XSLOCMAP 9/2/95 LDZ



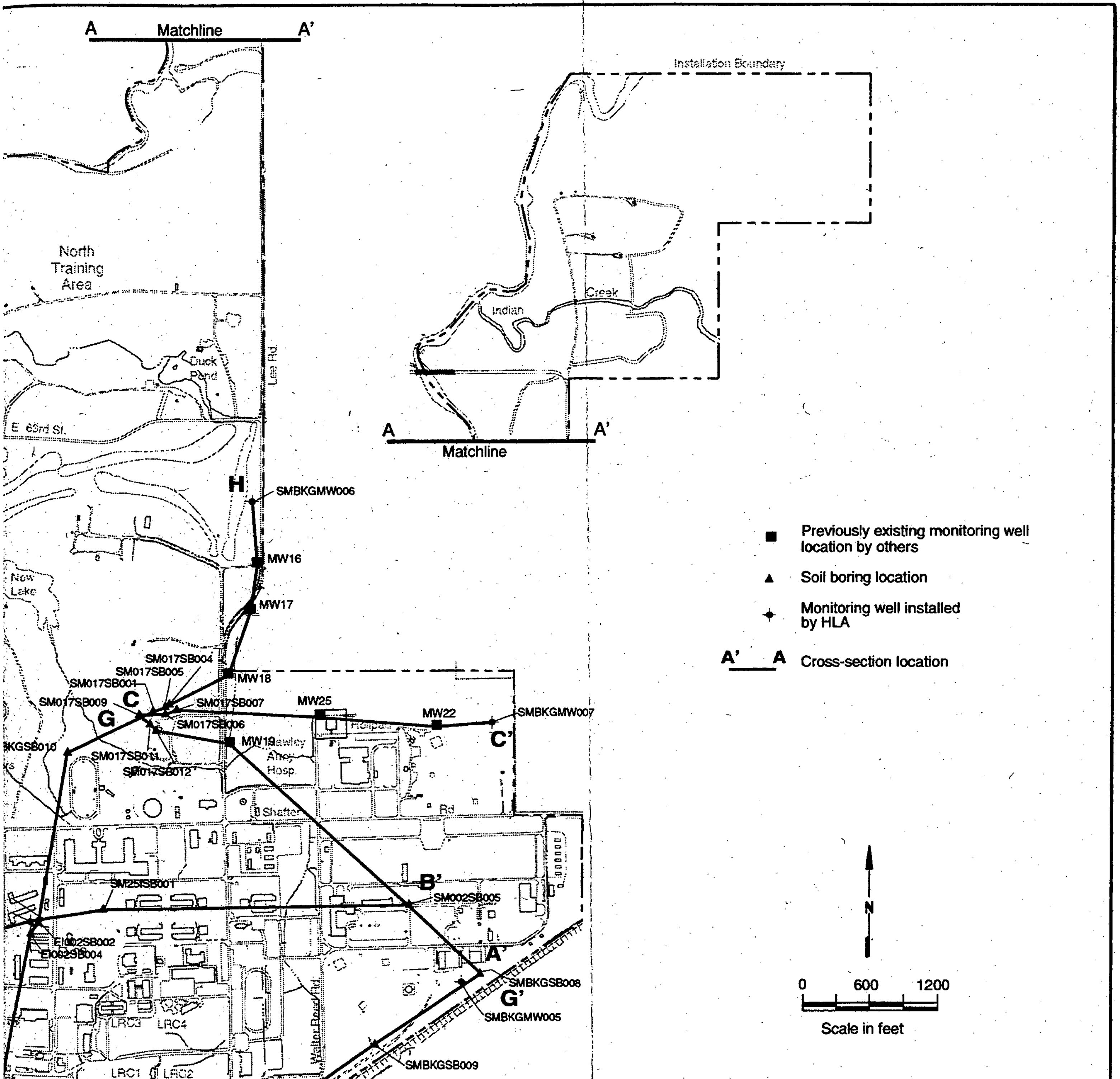


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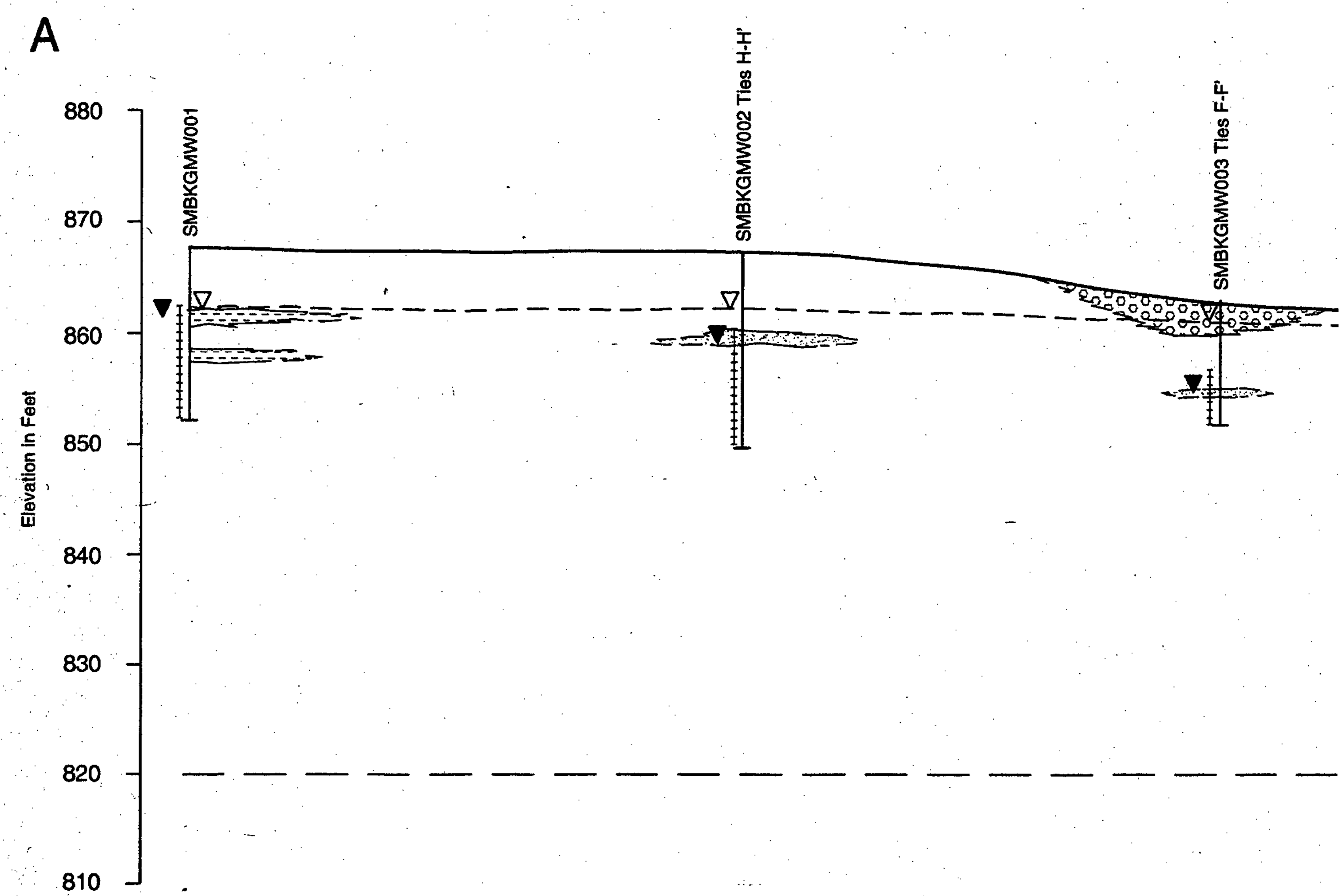
Figure 3.3

Geological Cross-Section Location Map



Explanation

Field Classification of Material

- Clay
- Silt
- Sand, fine to coarse
- Gravel
- ? Extent questionable
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

Boring or Well Information

- EI003SB005 Soil boring (SB) or monit well (MW) number
- Existing ground surface
- Screened interval
- Total depth

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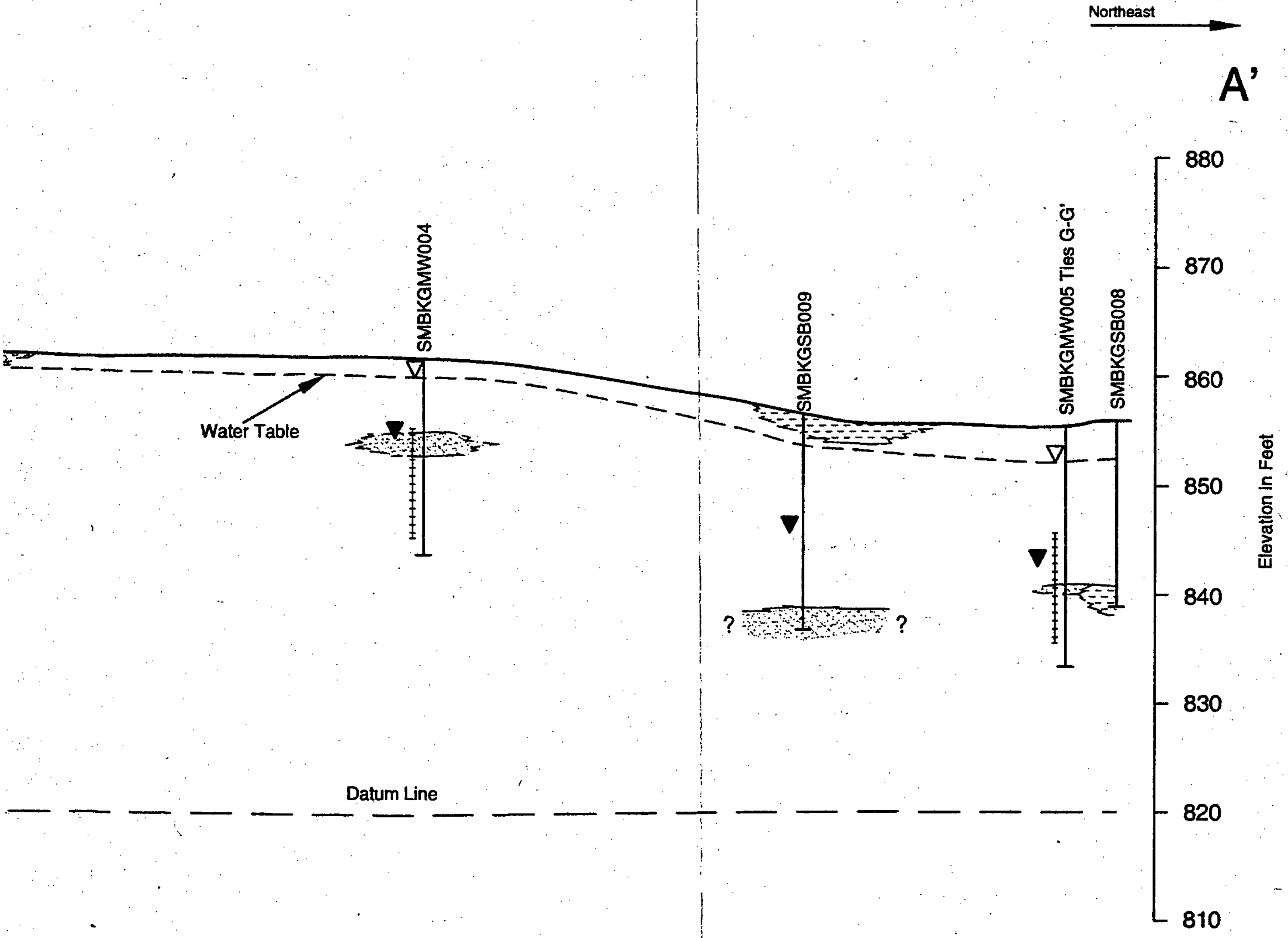

monitoring

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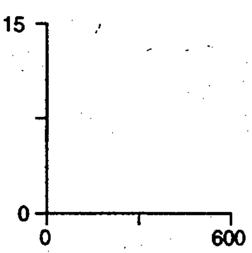

Scale in feet
Vertical exaggeration = 40x

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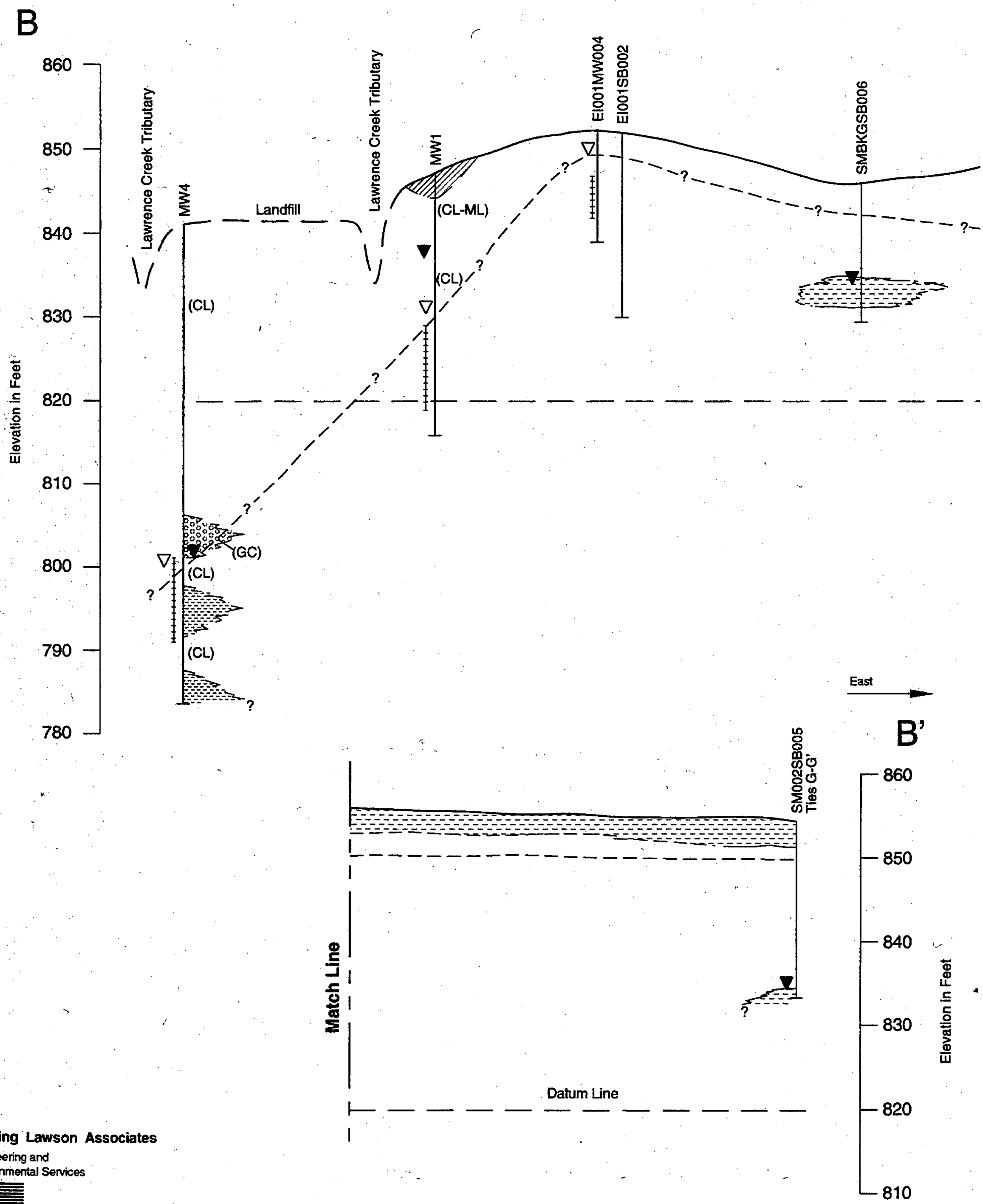
Figure 3.4 Geological Cross Section A-A'



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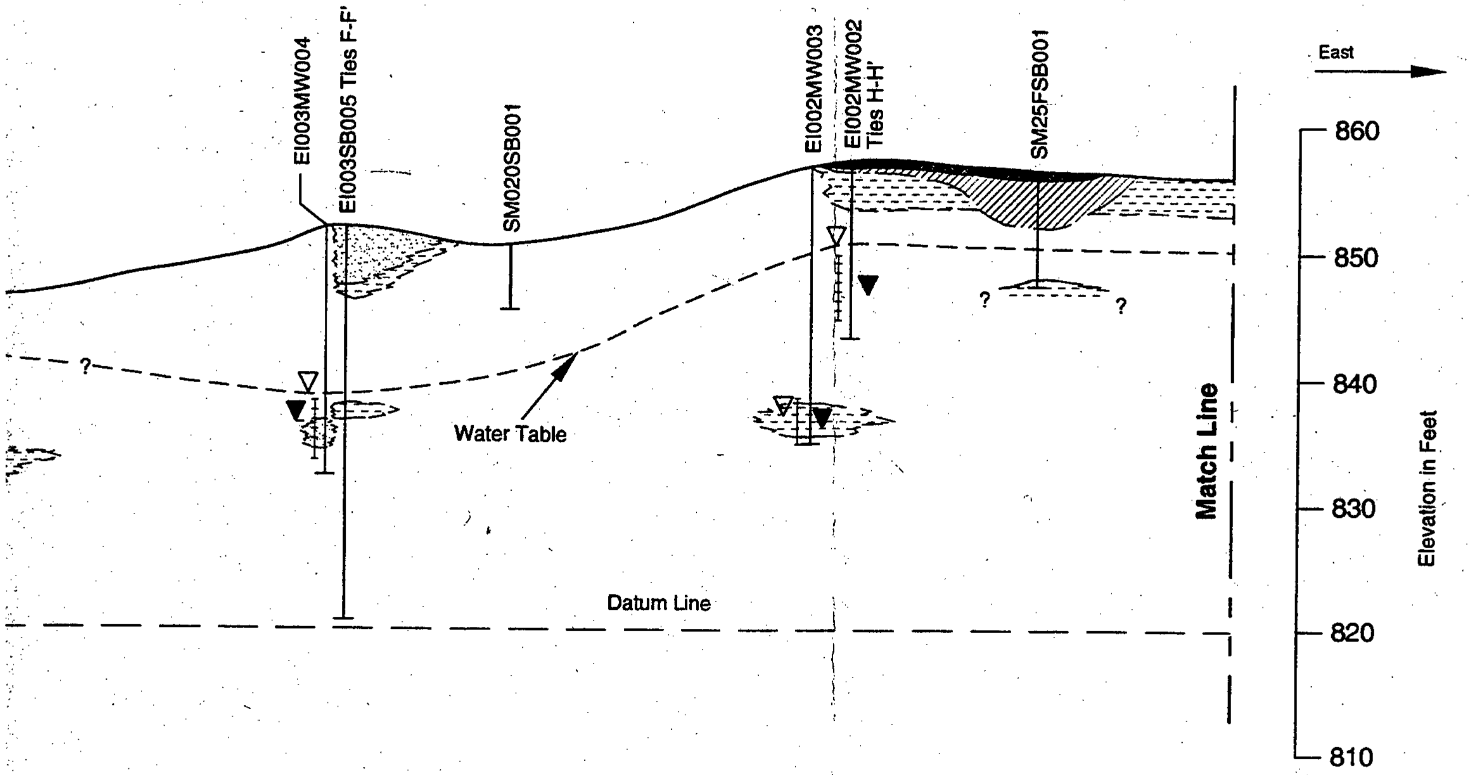


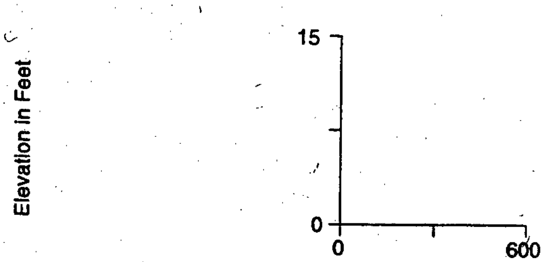
Explanation

Field Classification of Material

- Asphalt
- Fill
- Clay
- Silt
- Sand, fine to coarse
- Gravel
- ? Extent questionable
- (CL) Clay, poor quality log, lithology uncertain
- (GC) Clayey gravel, poor quality log, lithology uncertain
- (ML) Silt, poor quality log, lithology uncertain
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

Boring or Well Information

- EI003SB005 — Soil boring (SB) or monitoring well (MW) number
- Existing ground surface
- Screened interval
- Total depth



Scale in feet
Vertical exaggeration = 40x

Note:
Location and elevation of creeks are estimated from U.S. Army Corps of Engineers topographic map (February 1992).

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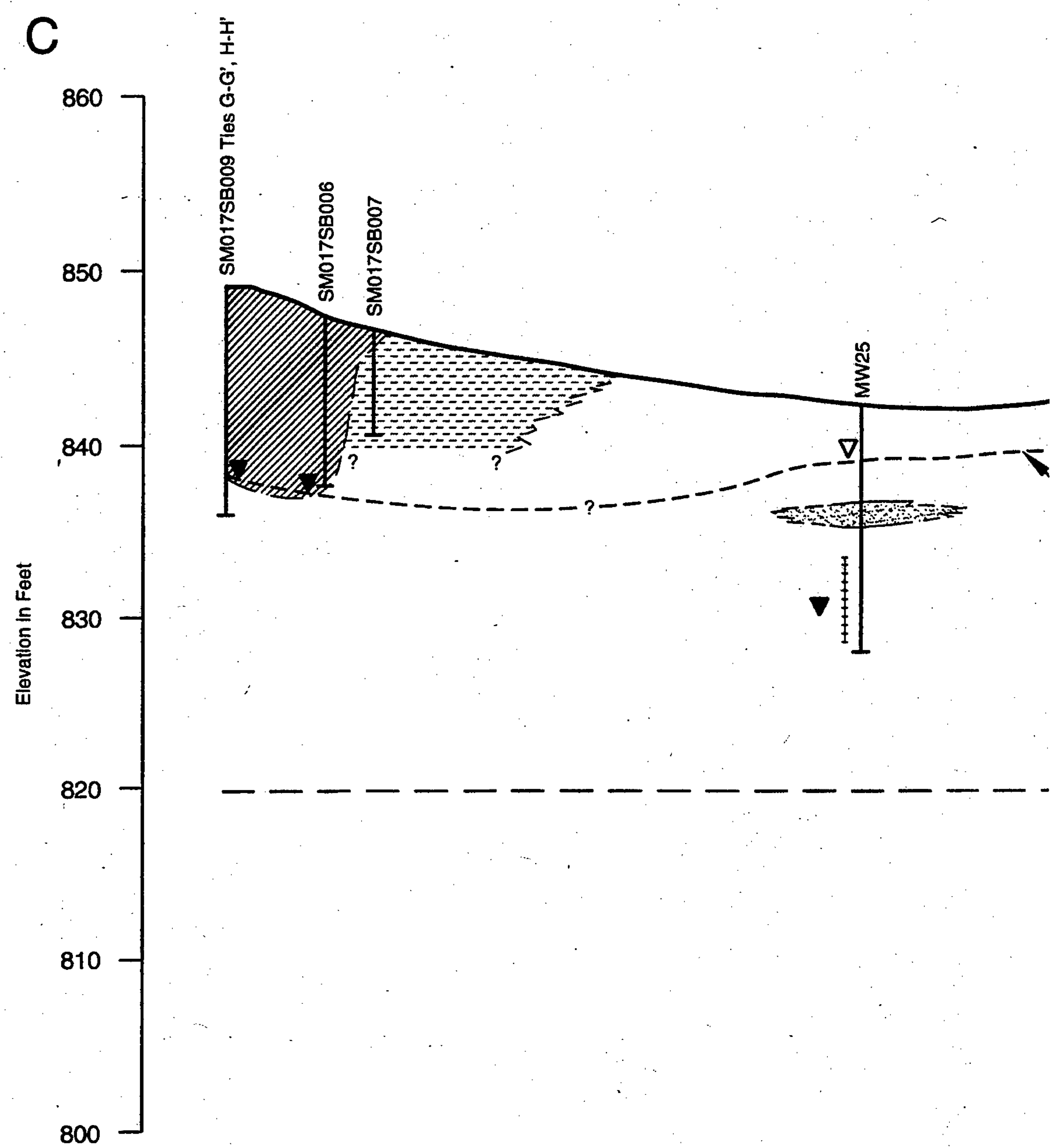
Figure 3.5

Geological Cross Section B-B'



Explanation

Field Classification of Material

- Fill
- Clay
- Silt
- Sand, fine to coarse
- ? Extent questionable
- (CL) Clay, poor quality log, lithology uncertain
- (SP) Sand, poor quality log, lithology uncertain
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

Boring or Well Information

- EI003SB005 Soil boring (SB) or monitoring well (MW) number
- Existing ground surface
- Screened interval
- Total depth

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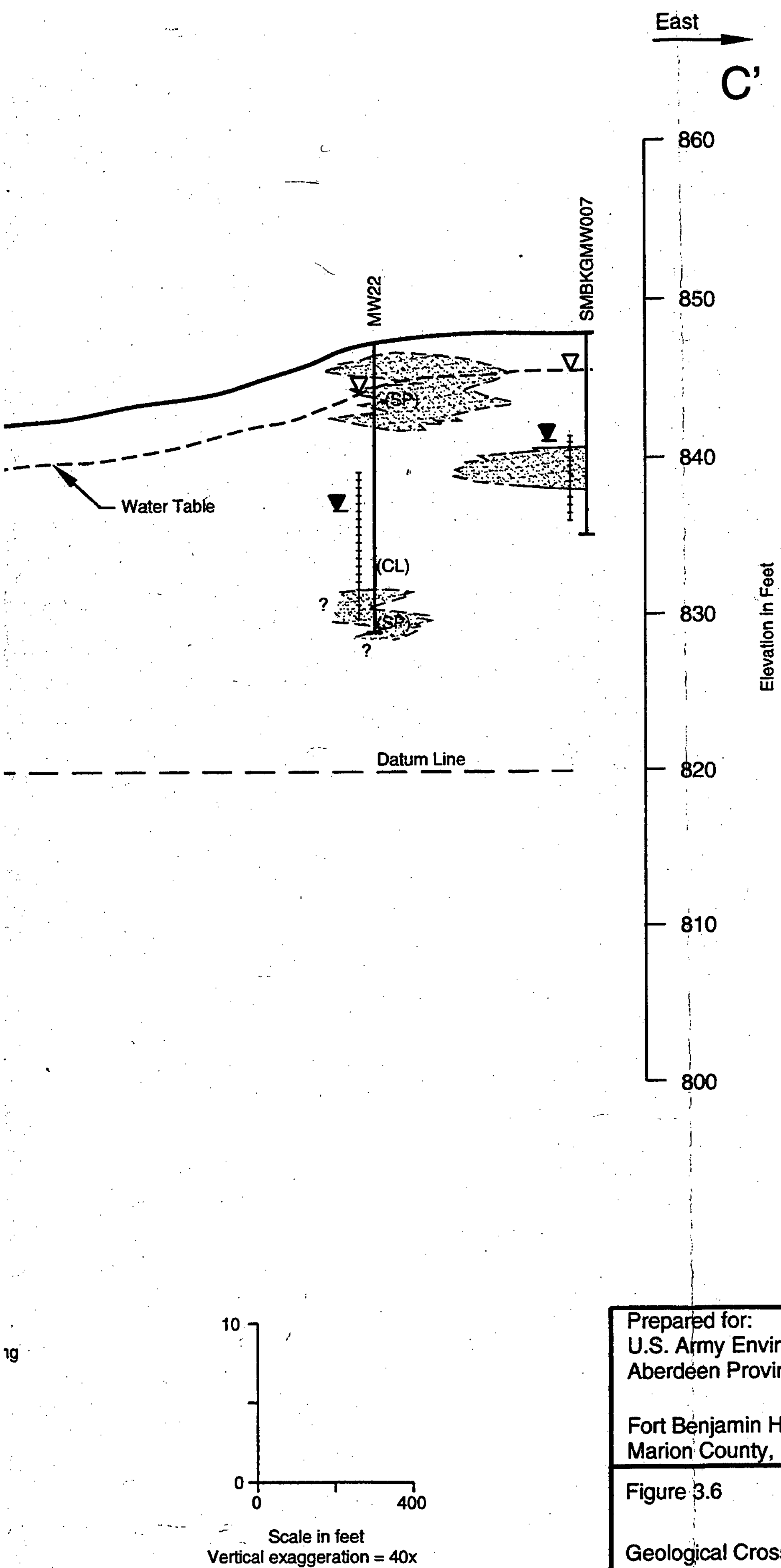

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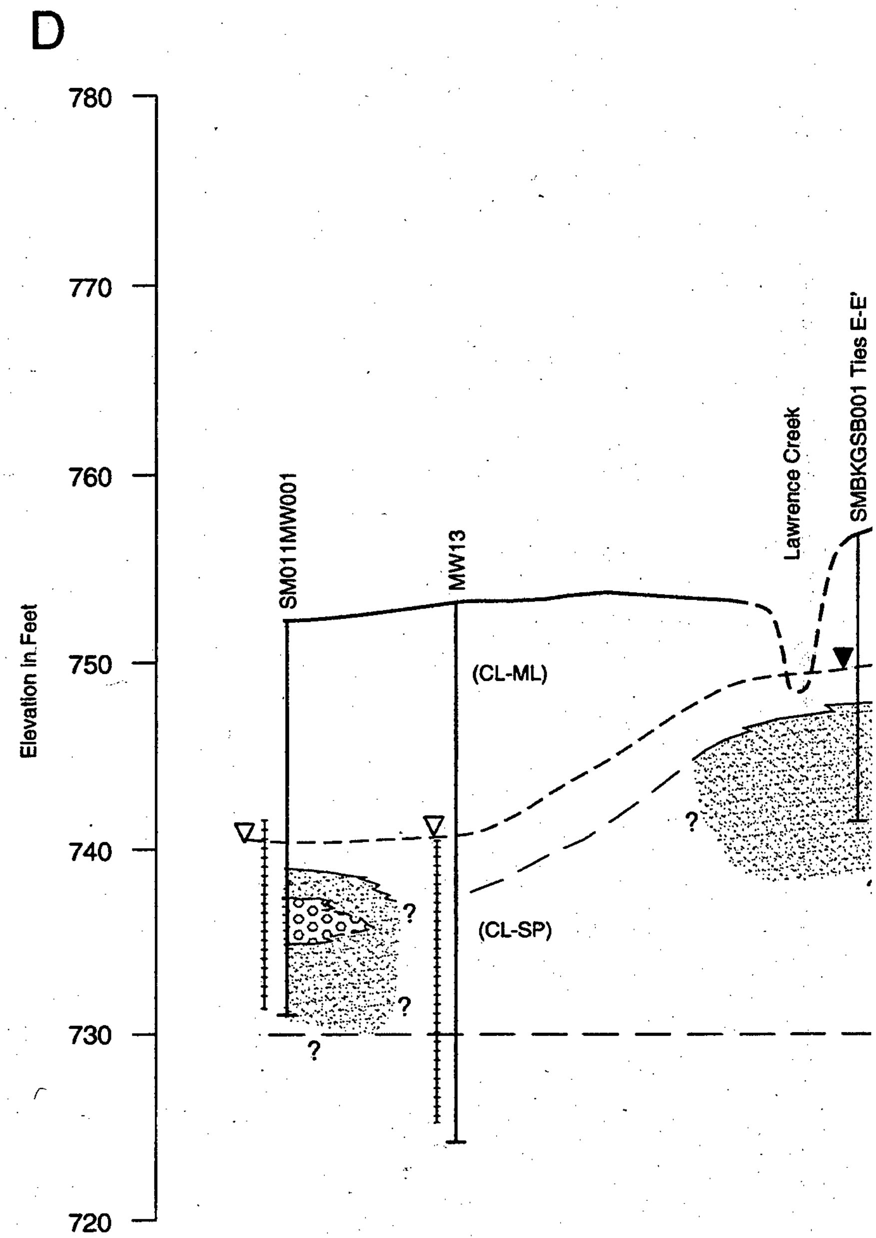
Figure 3.6

Geological Cross Section C-C'

2



Explanation

Field Classification of Material

- Clay
- Silt
- Sand, fine to coarse
- Gravel
- ? Extent questionable
- (CL) Clay, poor quality log, lithology uncertain
- (ML) Silt, poor quality log, lithology uncertain
- (SP) Sand, poor quality log, lithology uncertain
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

Boring or Well Information

- EI003SB005 Soil boring (SB) or monitoring well (MW) number
- Existing ground surface
- Screened interval
- Total depth

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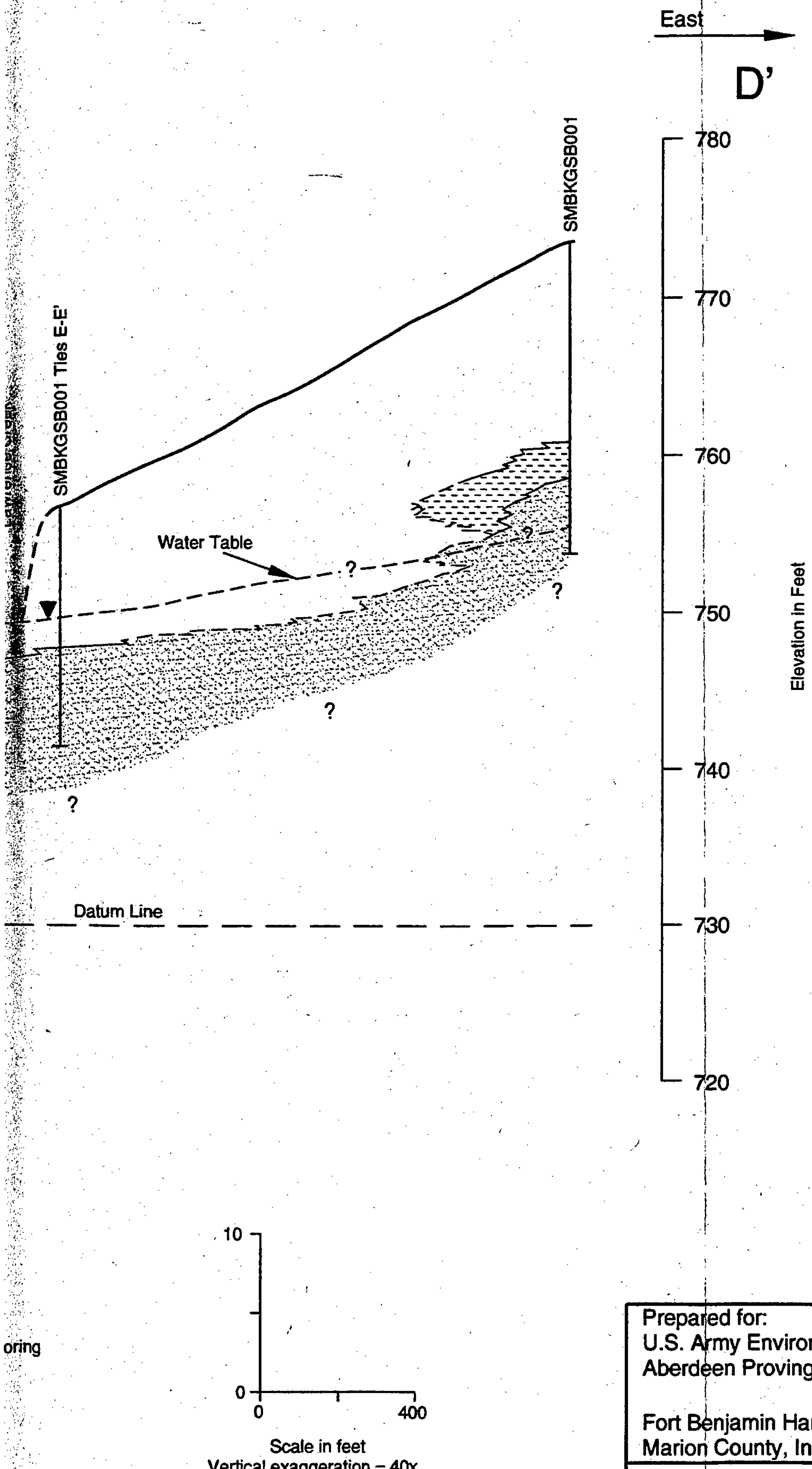

Note:
Location and elevation of
creeks are estimated from
U.S. Army Corps of Engineers
topographic map (February 1992).

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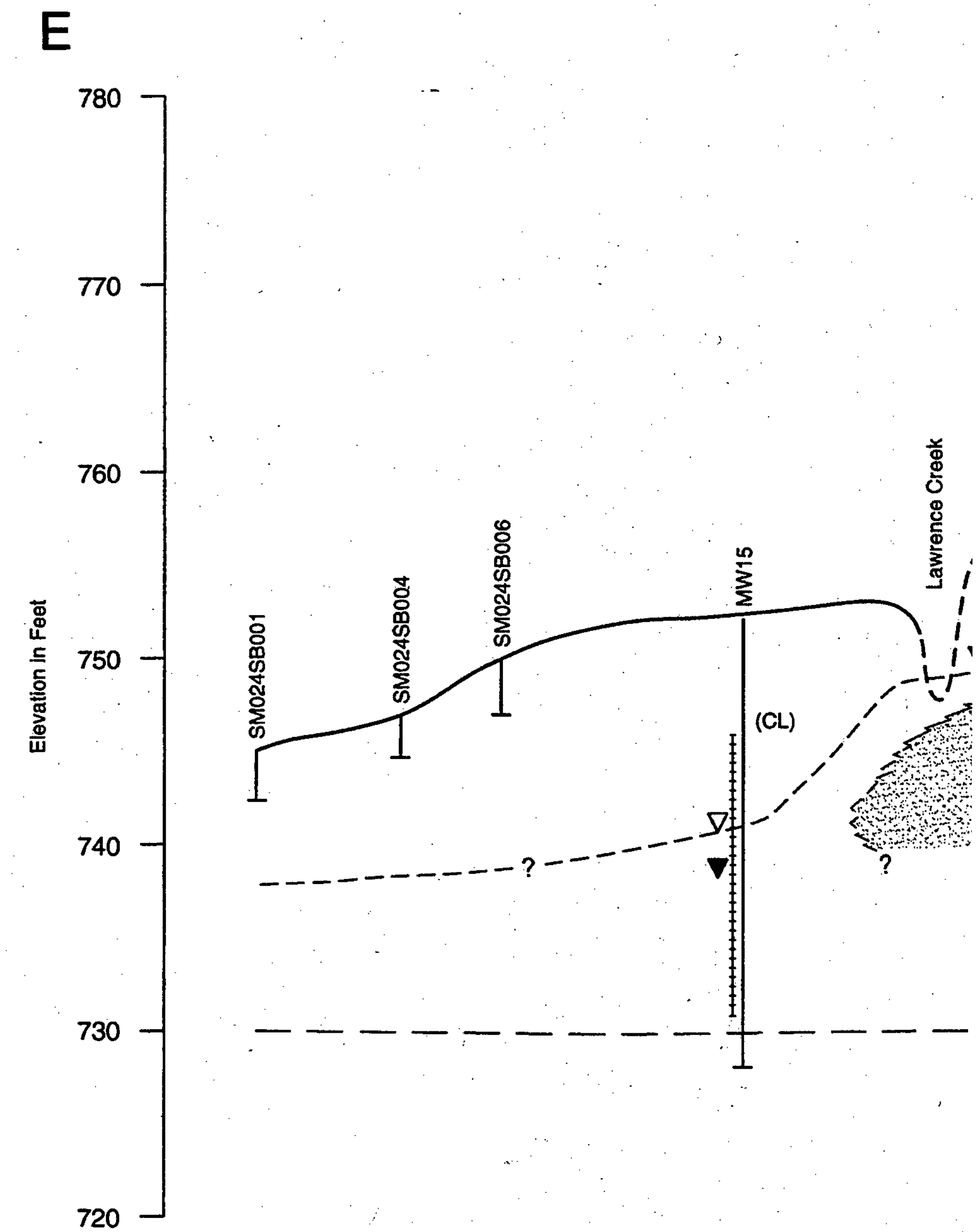
Figure 3.7

Geological Cross Section D-D'



Explanation

Field Classification of Material

- Clay
- Sand, fine to coarse
- ? Extent questionable
- (CL) Clay, poor quality log, lithology uncertain
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

Boring or Well Information

- EI003SB005 — Soil boring (SB) or monitoring well (MW) number
- Existing ground surface
- Screened interval
- Total depth

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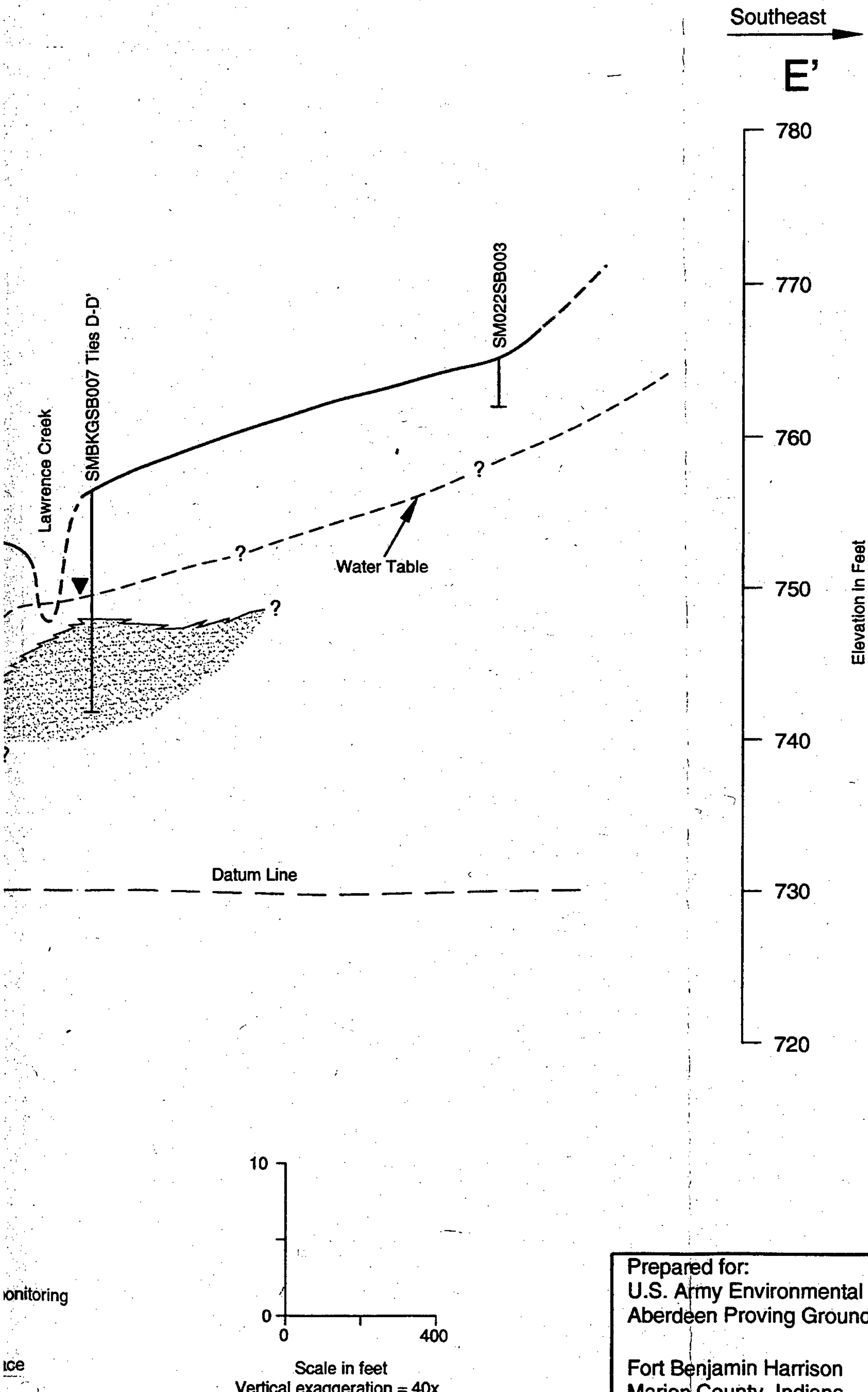

Note:

Location and elevation of creeks are estimated from U.S. Army Corps of Engineers topographic map (February 1992).

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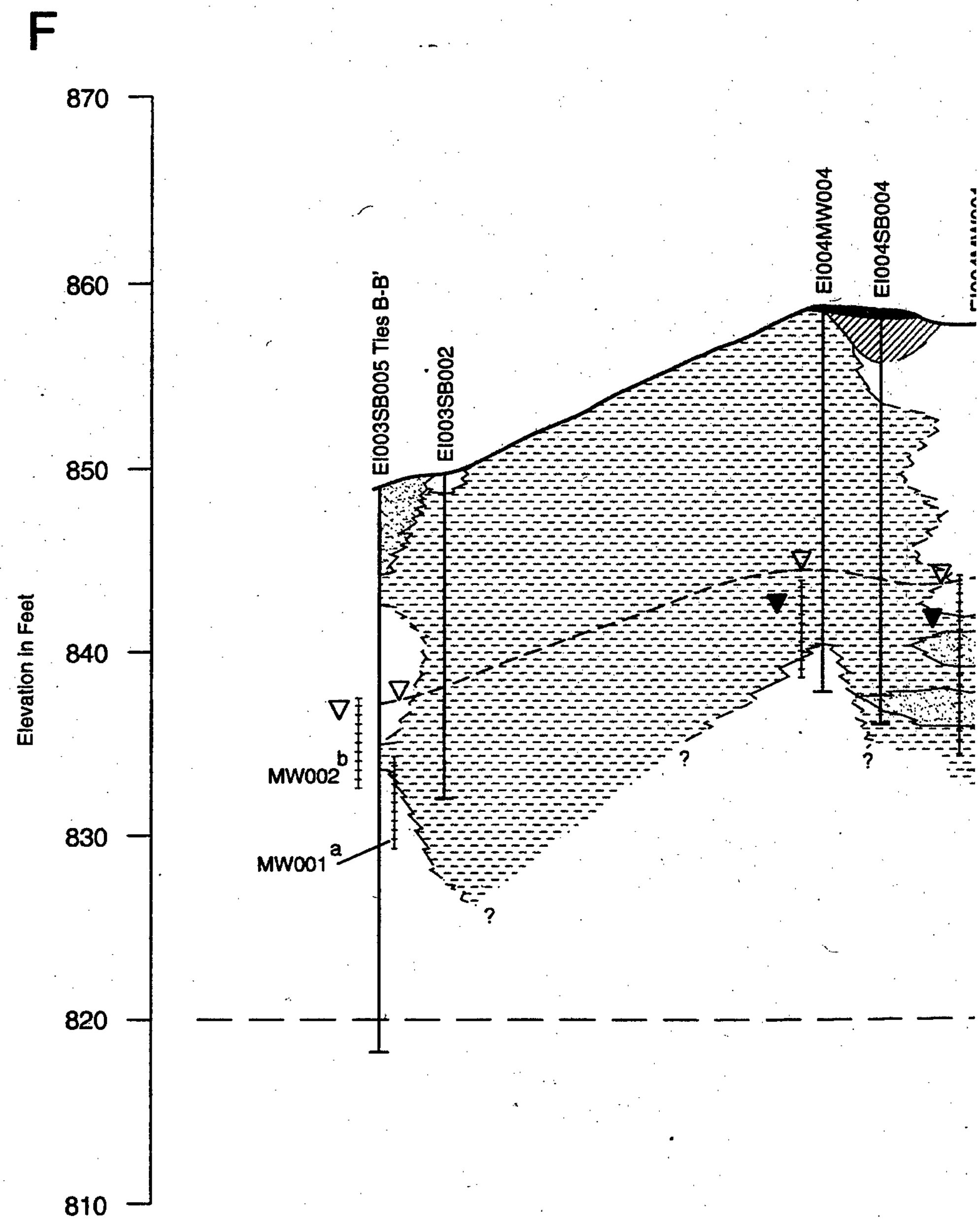
Figure 3.8

Geological Cross Section E-E'



Explanation

Field Classification of Material

- Asphalt
- Fill
- Clay
- Silt
- Sand, fine to coarse
- Gravel
- ? Extent questionable
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

Boring or Well Information

- EI003SB005 Soil boring (SB) or monitoring well (MW) number
- Existing ground surface
- Screened interval
- Total depth

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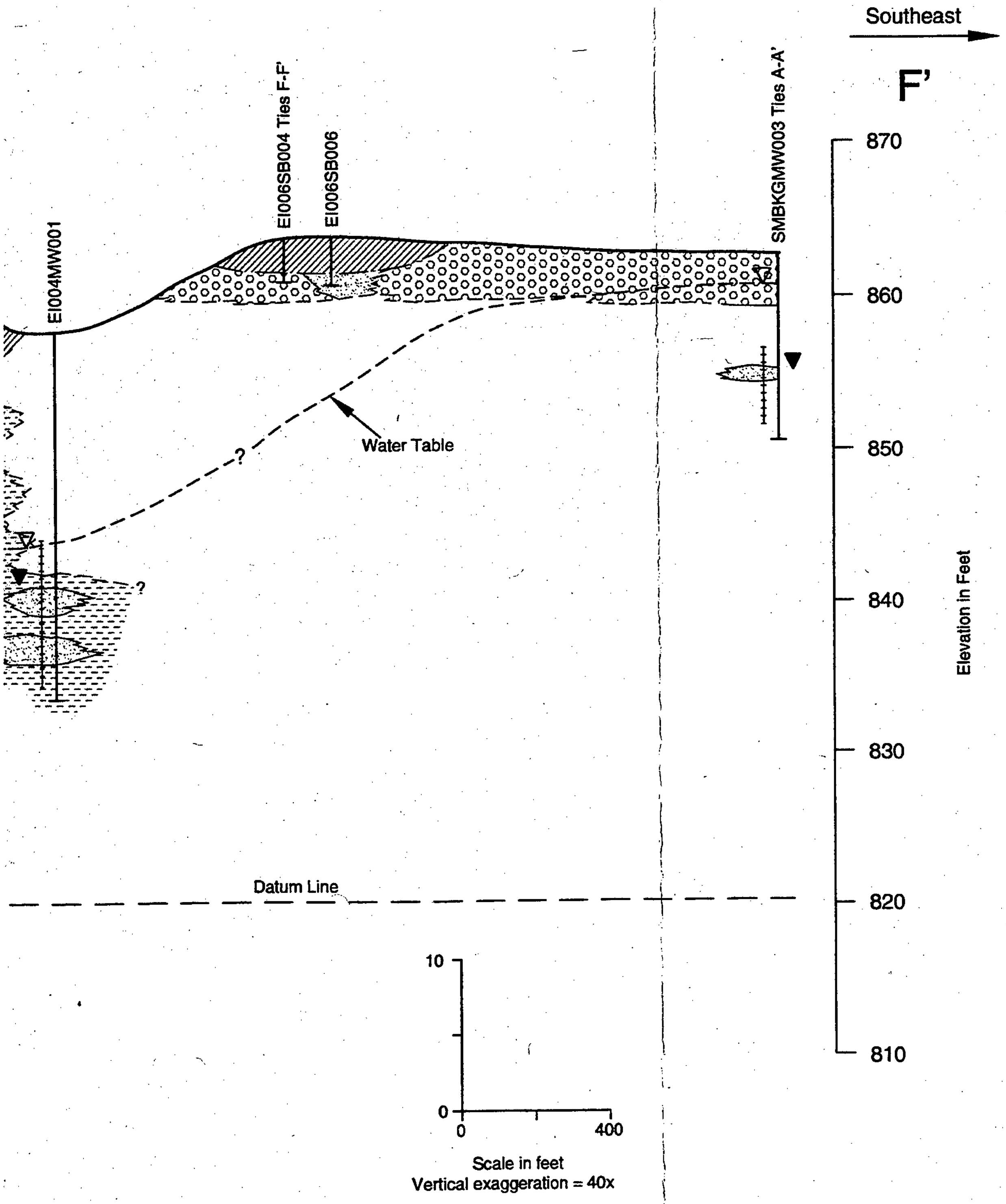

tes:

Location and elevation of creeks are estimated from U.S. Army Corps of Engineers topographic map (February 1992).

a EI003MW001 - Lithologic log shows silty, fine to medium sand from 7.5 ft. to 9.5 ft. and 10.0 ft. to to 11.0 ft. below surveyed ground surface elevation of 841.15 ft.

b EI003MW002 - Lithologic log shows fine to coarse sand with clay and gravel from 4.5 ft. to 7.0 ft. below surveyed ground surface elevation of 841.23 ft.

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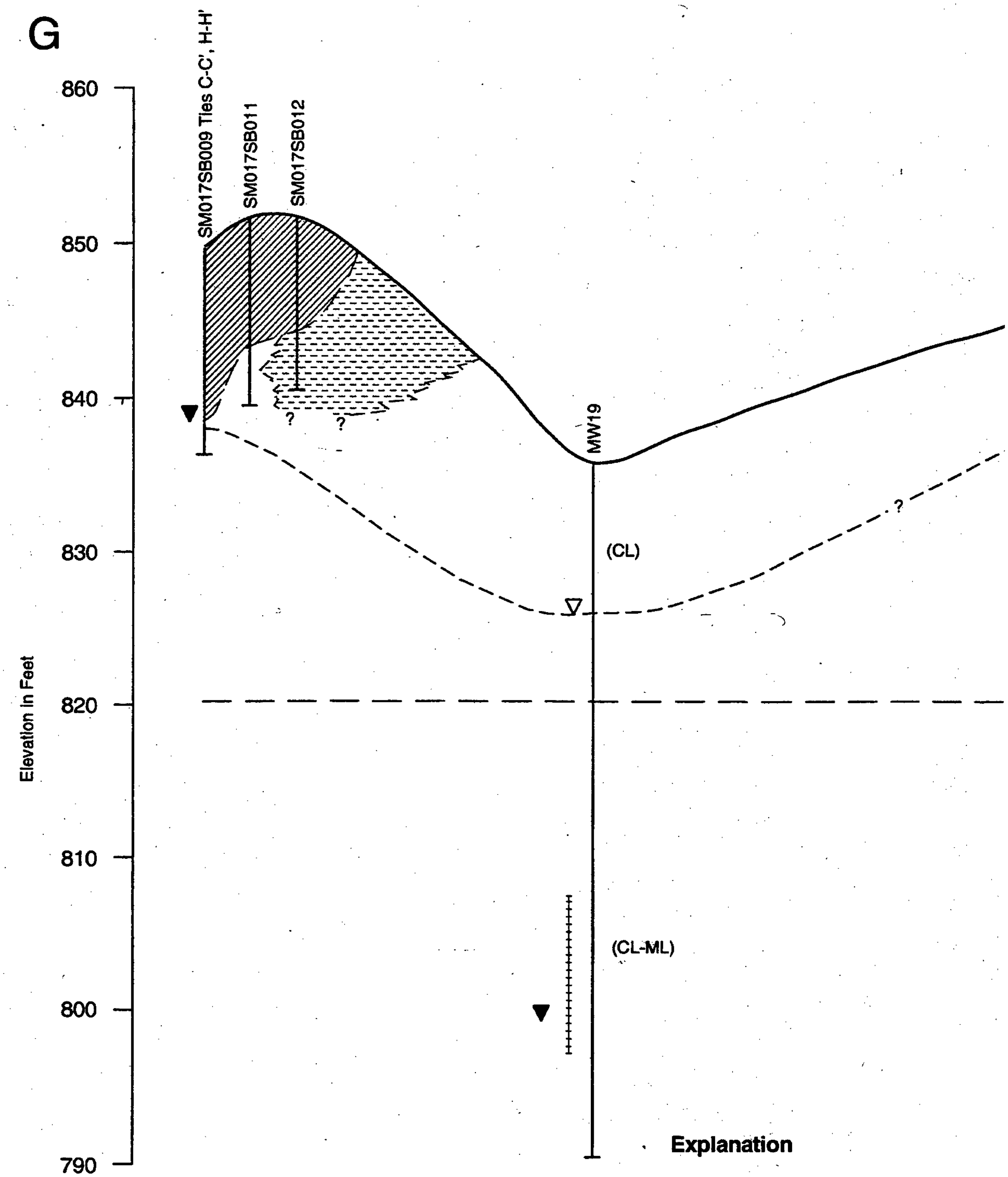
Figure 3.9

Geological Cross Section F-F'



Explanation

Field Classification of Material

- Fill
- Clay
- Silt
- Sand, fine to coarse
- ? Extent questionable
- (CL) Clay, poor quality log, lithology uncertain
- (ML) Silt, poor quality log, lithology uncertain
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

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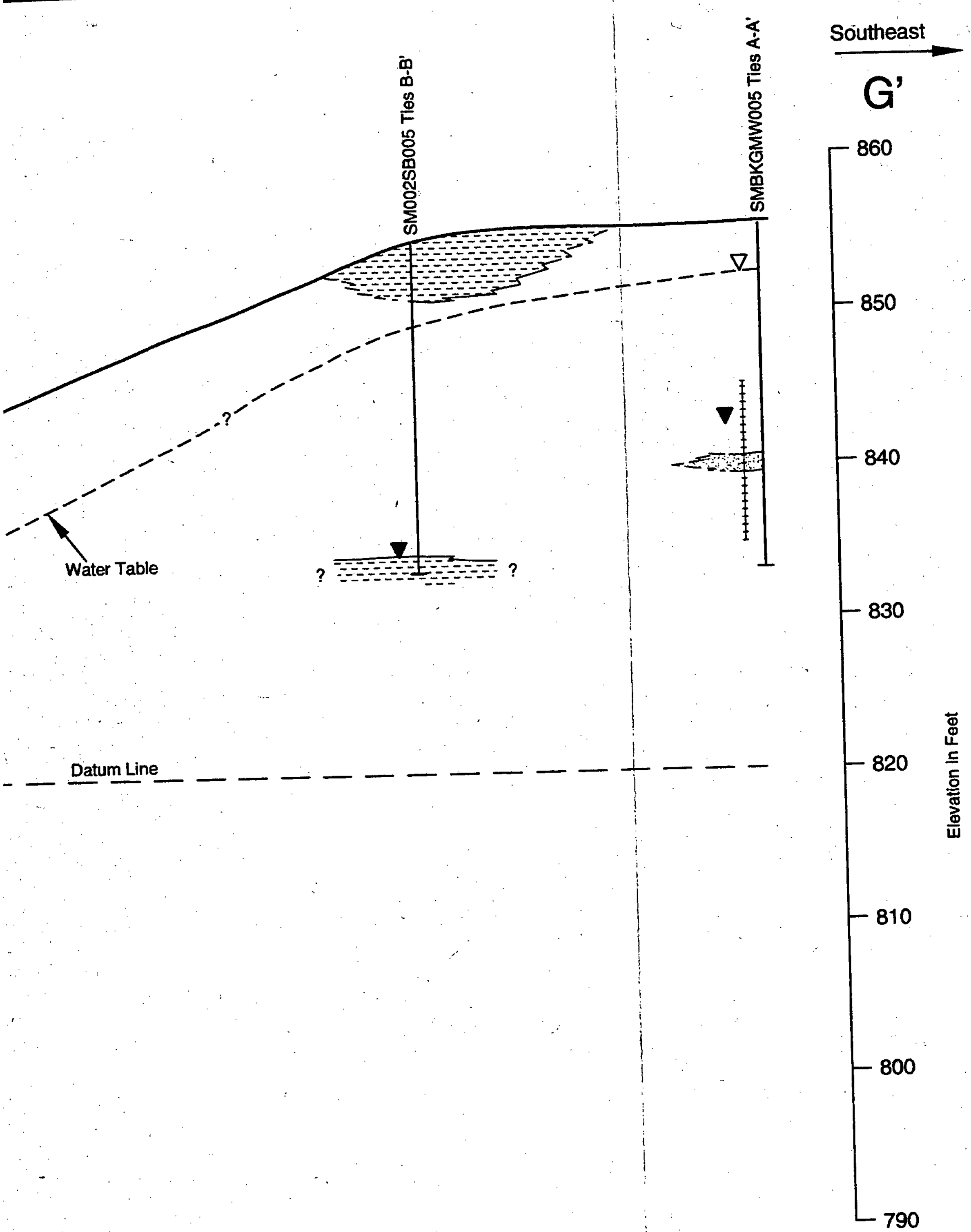

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MW) number

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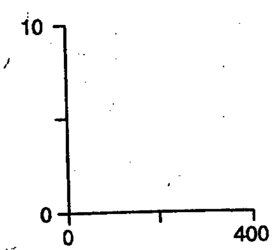

Scale in feet
Vertical exaggeration = 40x

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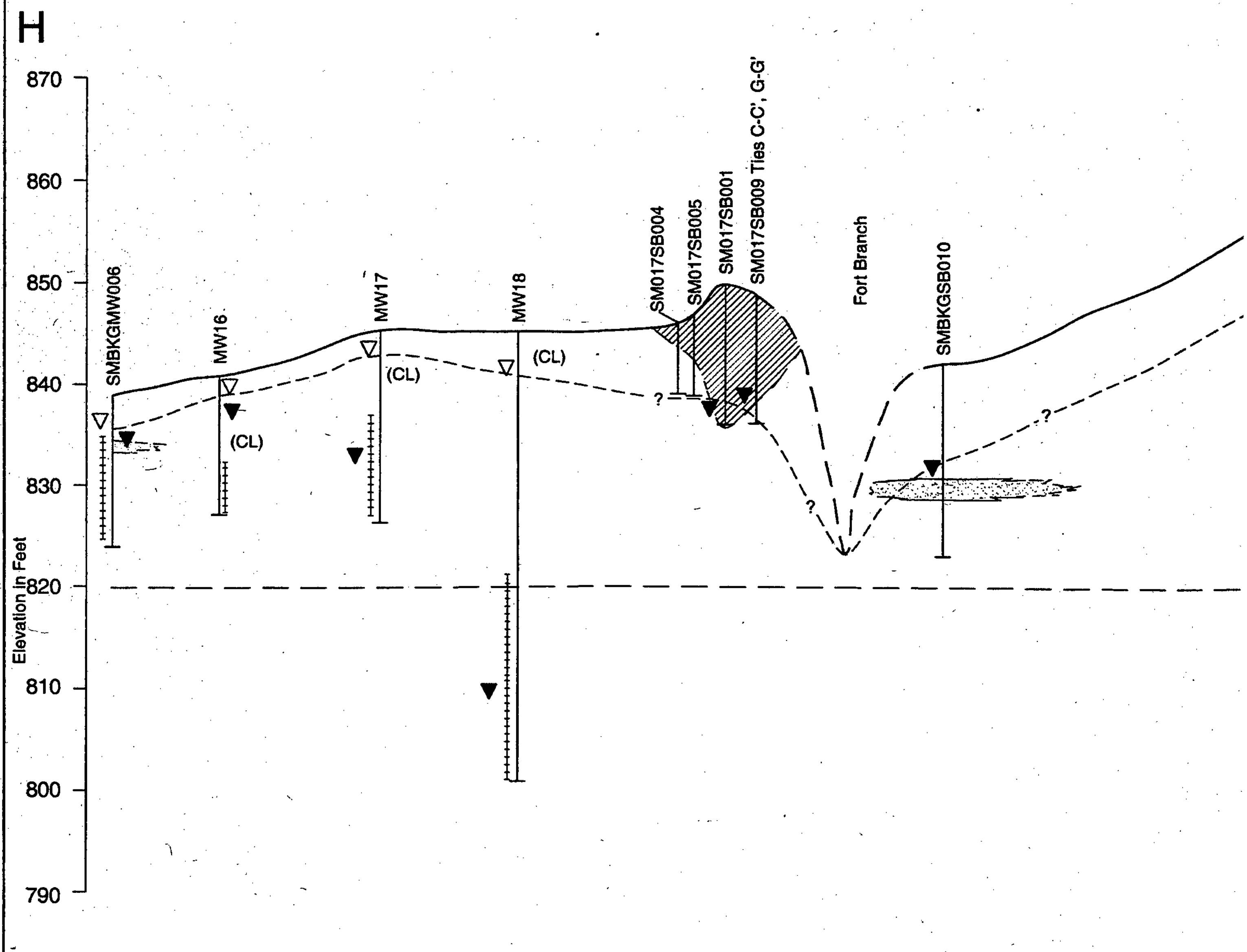
Figure 3.10

Geological Cross Section G-G'

2



Explanation

Field Classification of Material

- Asphalt
- Fill
- Clay
- Silt
- Sand, fine to coarse
- Gravel
- ? Extent questionable
- (CL) Poor quality log, lithology uncertain
- ▽ Water-level measurement taken February 14, 1994
- ▼ Water-level elevation estimated during drilling

Boring or Well Information

- EI003SB005 Soil boring (SB) or monitc well (MW) number
- Existing ground surface
- Screened interval
- Total depth

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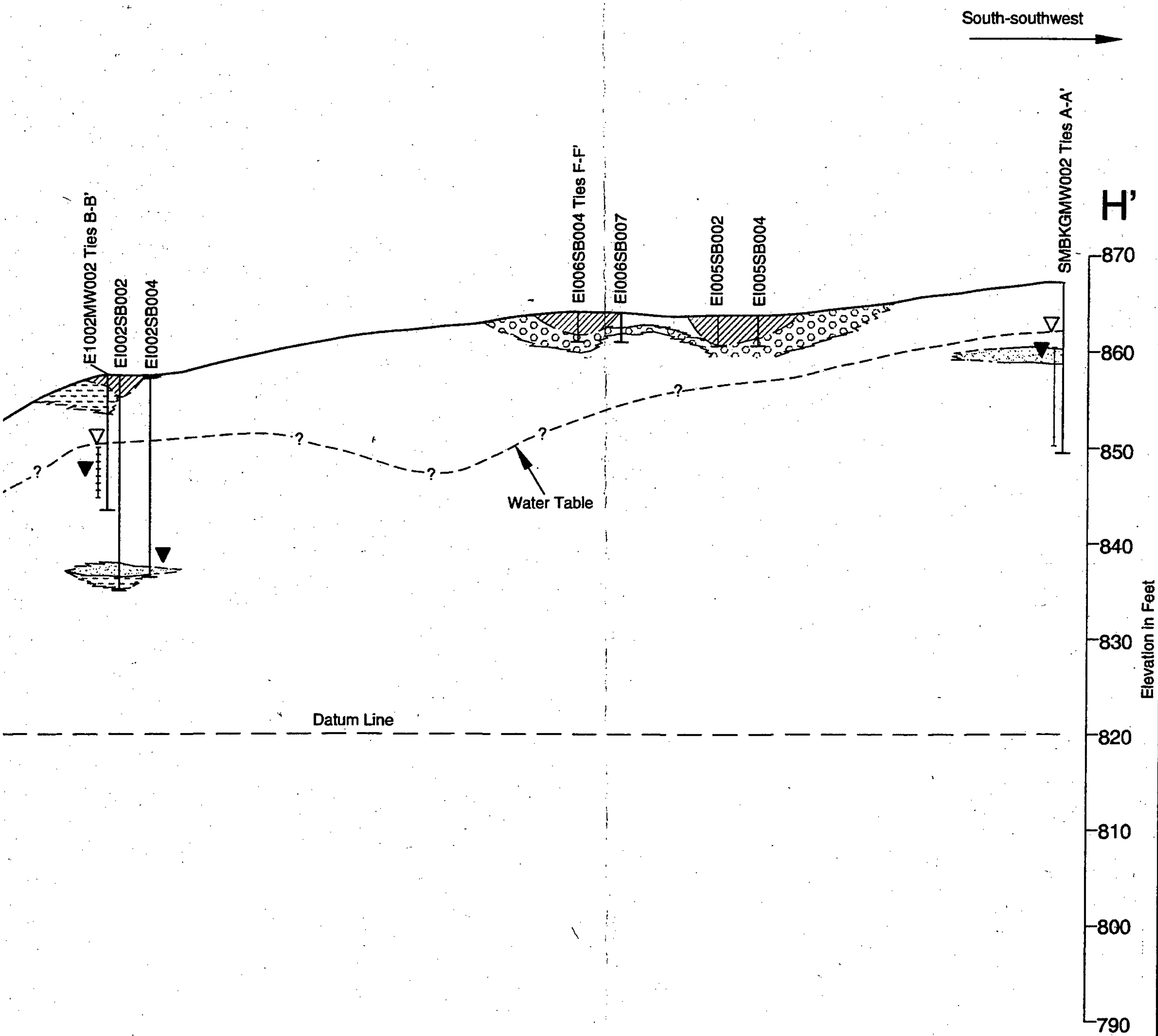

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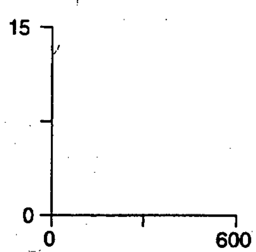

Scale in feet
Vertical exaggeration = 40x

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Figure 3.11

Geological Cross Section H-H'

2

4.0 PHASE I ENVIRONMENTAL INVESTIGATION AND FINDINGS BY SITE

Twenty-eight sites were investigated during the EI at FBH. The site descriptions, investigative activities, investigation results, conclusions, and recommendations for each of the 28 EI sites are presented in the following sections. Table 3.1 presents a summary of the Phase I field investigation activities. Table 3.2 presents a summary of the Phase I samples and analyses.

4.1 EI Site 1: Auto Craft Shop, Building 705

The self-help Auto Craft Shop in Building 705 is used by Army personnel and their dependents to work on personal vehicles. The Directorate of Personnel and Community Activities (DPCA) manages the Auto Craft Shop, Building 705. Vehicle maintenance operations conducted at the Auto Craft Shop include the following:

- Oil changing
- Tire and battery storage, replacement, and service
- Brake repair
- Electrical systems repair
- Parts cleaning and degreasing
- Engine tuneups

Building 705, shown in Figure 4.1, has a concrete floor with floor drains that drain to an oil/water separator. Based on information from FBH personnel, the discharge point of the floor drain and oil/water separator is to a sanitary sewer.

4.1.1 Investigation Activities Performed

The investigation activities performed at Building 705 consisted of a records review, field screening, investigation sampling, and land surveying. These activities are discussed in the following subsections.

4.1.1.1 Records Review

Until 1982, waste oil was contained in 55-gallon drums that were stored inside Building 705 at a drum accumulation area. Waste oil was stored in a UST near the northeast corner of Building 705. According to the Army, the waste-oil UST was removed during 1992 before Phase I field activities began. USTs are being addressed under other regulatory programs (e.g., State of Indiana UST/LUST and federal guidelines), and the adequacy of the UST closure is not part of this EI. Petroleum, oils, and lubricants (POLs) are stored in a plastic secondary containment basin located outside near the northeast corner of Building 705.

4.1.1.2 Field Screening

Field screening activities consisted of collecting and analyzing soil-gas samples. The soil-gas survey was performed to screen the site for the absence or presence of the volatile fraction of solvents or POL in the subsurface soil. Initially, 20 soil-gas samples were to be collected from locations spaced at approximately 25-foot intervals around the perimeter of Building 705, as shown in Figure 4.1. Two additional soil-gas samples were to be collected along the first 50 feet of the sewer lateral to Building 705. In practice, soil-gas samples were collected at 3 locations (E01-13, E01-16, and E01-22) at depths of 3 to 3.5 feet bgs. At the remaining 19 locations shown in Figure 4.1, the soil was of such low permeability that soil-gas samples could not be collected. Soil-gas samples were analyzed for VOCs. Soil-gas sampling procedures are discussed in Appendix A of the TSP (HLA, 1993a).

4.1.1.3 Investigation Sampling

The field investigation at the Auto Craft Shop, Building 705, consisted of the following activities:

- Collection and analysis of 15 subsurface soil samples from 5 soil borings, 2 duplicates from 2 soil borings, and 3 replacement samples from 1 replacement boring
- Installation of 4 monitoring wells and 1 round of groundwater sampling

Soil and groundwater samples collected from this site were analyzed for VOCs and TPH. Soil samples were also analyzed for cyanide and total metals. Soil and groundwater samples were

analyzed for VOCs and TPH because general automotive repair and maintenance activities using solvents and POLs are known to have occurred at this site. Soil samples were analyzed for cyanide and total metals because used oil may have been stored onsite. The individual compounds included in these analytical suites are presented in Section 3.1.

A summary of Phase I sampling rationale and locations at the Auto Craft Shop, Building 705, are provided in Table 4.1. Field investigation activities performed at this site are described in more detail in the following sections.

Soil Borings and Subsurface Soil Sampling

Five soil borings (EI001SB001 through EI001SB005) were drilled to the water table to verify the limited soil-gas survey results. The 5 boring locations are shown in Figure 4.2. Boring locations were revised from the proposed locations shown in the TSP (HLA, 1993a) on the basis of soil-gas survey results, site conditions, and locations of underground utilities. One boring was placed on each side of Building 705 in locations that were assessed as likely POL or solvent spill or disposal areas. A second boring was located north of Building 705 because of VOCs detected in soil gas on the north side. Originally, 1 boring was to be sampled continuously to provide a complete lithologic description of the total depth explored. The 4 remaining borings were proposed to be sampled at 5-foot intervals for descriptive purposes. In general, it was necessary to collect soil samples at intervals more closely spaced than those proposed in the TSP (HLA, 1993a) to accurately establish the depth at which groundwater was first encountered during drilling so that samples would not be collected beneath the water table. This was necessary because the flow of groundwater into borings during drilling was sometimes negligible or nonexistent due to the low permeability of the fine-grained materials that were being drilled. Three soil samples per boring were collected for chemical analysis at depths of approximately 1 to 2 feet bgs, 4 to 5 feet bgs, and from soil immediately above the water table unless poor sample recovery precluded the collection of samples at these depths. Soil boring logs are presented in Appendix H.

After selected soil samples from Boring EI001SB003 were received by the laboratory for chemical analysis, the laboratory's refrigerator in which the samples were stored malfunctioned overnight, allowing the temperature of the samples to rise above the specified holding temperature of 4° C. Sample integrity was invalidated by this refrigerator malfunction. Replacement samples were collected by drilling a replacement boring (EI001SB03A) within a few feet of Boring EI001SB003.

Monitoring Well Installation and Groundwater Sampling

Four monitoring wells (one upgradient [EI001MW001] and 3 downgradient [EI001MW002, EI001MW003, and EI001MW004]) were installed during the Phase I field investigation at EI Site 1. Monitoring well locations are shown in Figure 4.2. These locations were the same as the proposed locations shown in the TSP (HLA, 1993a) except for Monitoring Well EI001MW001, which was relocated closer to the building to avoid underground utilities. The monitoring wells were installed to assess shallow groundwater quality and flow direction. Monitoring well construction diagrams are presented in Appendix H; well design modifications are discussed in Subsection 3.1.6.1.

The monitoring wells were sampled once during Phase I to assess upgradient and downgradient shallow groundwater quality at the site. Groundwater samples were analyzed for VOCs and TPH. Monitoring well development and groundwater sampling procedures were revised from those proposed in Appendix A of the TSP (HLA, 1993a) because of the slow groundwater recharge rates of most wells as a result of the low permeability soil. A discussion of the revised procedures is presented in Section 3.0.

4.1.1.4 Land Survey

All monitoring wells were surveyed for Universal Transverse Mercator (UTM) x- and y-coordinates, latitude and longitude, and elevations in feet above NGVD by a licensed surveyor registered in the State of Indiana. Surveying procedures are discussed in Appendix A of the TSP (HLA, 1993a). Surveying data are presented on Plate 2.

4.1.2 Results of Investigation

The results of the investigation are discussed by media in the following subsections. The analytical suites for each of the media are also discussed.

4.1.2.1 Field Screening Results (Soil-Gas Survey)

Soil-gas samples were collected from EI Site 1 at Locations E01-13, E01-16, and E01-22 at depths ranging from 3 to 3.5 feet bgs. The soil-gas samples were found to contain 1,1,1-trichloroethane (1,1,1-TCA); tetrachloroethene (PCE); 1,1-dichloroethane (1,1-DCA); trichloroethene (TCE); toluene; and TVH. The constituents identified are solvents commonly used in vehicle maintenance. The highest soil-gas concentrations were observed in the sample collected from E01-22. The analytical results for these 3 samples are summarized in Table 4.2 and presented in Figure 4.3.

4.1.2.2 Subsurface Soil Samples

Analytical results for metals detected at concentrations greater than IDEM background concentrations are summarized in Table 4.3. Detected concentrations of organic compounds and landfill parameters for which background has not been established are summarized in Table 4.4. Figure 4.2 shows soil boring locations where the subsurface soil samples were collected at EI Site 1. Figure 4.4 shows the analytical results of subsurface soil samples collected at this site that exceed the IDEM background concentrations, or where detections of organic compounds were reported.

Metals

Metals concentrations exceeding IDEM background were detected in one or more subsurface soil samples collected from each boring sampled at EI Site 1. Fifteen metals exceeded subsurface soil IDEM background concentrations in subsurface soil samples collected at EI Site 1 (Table 4.3). The number of metals exceeding IDEM background subsurface soil concentrations ranged from 5 in subsurface soil samples collected from Boring EI001SB004 to 14 in subsurface soil samples from Borings EI001SB003 and EI001SB005. Of the 15 metals exceeding IDEM background metals concentrations in subsurface soil samples from EI Site 1, thallium, arsenic, and barium were the most

frequently detected metals, with 14 detection of thallium and 10 detections each of arsenic and barium with the highest concentrations at 41 milligrams per kilogram (mg/kg), 16 mg/kg, and 291 mg/kg, respectively.

Although metals concentrations frequently exceeded the IDEM background concentrations, the metals exceeding IDEM background are not related to known site activities. Metals concentrations exceeding IDEM background are found in both fill material and native soil. The occurrence of metals exceeding IDEM background concentrations is not related to the occurrence of petroleum products in soil. (TPH was reported in only one subsurface soil sample.) In addition, thallium, the metal most frequently exceeding IDEM background, is not reported as a common constituent in used oil (Mueller Associates, Inc., 1989).

Organics

Two organic compounds (acetone and 1,1,2-trichlor-1,2,2-trifluoroethane) and TPH (diesel fuel) were detected in subsurface soil samples collected at EI Site 1. 1,1,2-Trichlor-1,2,2-trifluoroethane is a tentatively identified compound (TIC). TICs are nontarget compounds that were identified by the laboratory on the basis of a review of the mass spectrum of the compounds during analysis and are reported here for completeness (Table 4.4). The TICs are identified in the table with an "S" qualifier. The organic compounds were detected in subsurface soil samples collected from each boring drilled at depths ranging from 2.0 to 9.0 feet bgs. Acetone and 1,1,2-trichlor-1,2,2-trifluoroethane (a freon compound) were the most frequently detected organic compounds with 8 and 5 detections, respectively (Table 4.4). However, the concentrations of these compounds were relatively low (less than 0.04 mg/kg), and both of these compounds are common laboratory solvents and may not be related to site activities.

TPH (diesel fuel) was detected in 1 subsurface soil sample at a concentration of 14.4 mg/kg. It is not known whether the contamination originated from a surface or a subsurface source such as a UST.

However, the concentrations are below the state action level for TPH (100 ppm) for LUSTs (Oliver and others, 1993).

4.1.2.3 Groundwater Samples

On the basis of known site history, groundwater samples were analyzed for VOCs and THP at EI Site 1. Figure 4.2 shows monitoring well locations where the groundwater samples were collected at EI Site 1. On the basis of the water-level survey performed on February 14, 1994, the groundwater flows toward the northwest at the site (Plate 1). Figure 4.4 shows the analytical results of groundwater samples collected at this site where detections of organic compounds were reported.

Inorganic analytes above IDEM background concentrations were not detected in groundwater samples collected from monitoring wells at EI Site 1. Only 1 organic compound (chloromethane) was detected at a concentration of 2.0 $\mu g/l$ in the groundwater sample from Monitoring Well EI001MW004 (Table 4.5). Because this was the only analyte detected, an assessment of whether this site was affecting groundwater quality by comparing analytical results of the groundwater sample collected from the upgradient monitoring well to analytical results of groundwater samples collected from the 3 downgradient monitoring wells was not performed for this site.

4.1.3 Conclusions

Based on the results of the investigation at EI Site 1, the following conclusions have been made:

- Soil-gas results indicated the detection of 5 VOCs at low concentrations in the 3 soil-gas samples collected at the site.
- Subsurface soil metals concentrations exceeded IDEM background concentrations in samples from all 5 borings drilled. Thallium, arsenic, and barium were the most frequently detected metals. The occurrence of metals exceeding background is not related to known site activities.
- Subsurface soil detections of organic compounds were reported by the laboratory for acetone; 1,1,2-trichlor-1,2,2-trifluoroethane; and TPH. The occurrence of acetone and 1,1,2-trichlor-1,2,2-trifluoroethane is probably caused by laboratory contamination.
- TPH was identified in 1 soil sample at concentrations below IDEM action levels for TPH at UST sites.

- One groundwater detection of an organic compound was reported by the laboratory for chloromethane; this occurrence was probably caused by laboratory contamination of the sample.

4.1.4 Recommendations

Phase II activities for this site include additional sampling, background evaluation, and risk assessment as described below:

- Groundwater should be resampled for VOCs to confirm that groundwater quality has not been adversely affected because the source of the solvents found in soil-gas samples was not identified.
- A risk assessment should be performed for any identified chemicals of concern following sampling and reassessment of background conditions.

4.2 EI Site 2: Roads and Grounds Vehicle Maintenance Shop, Building 422

A former POL waste storage area at Building 422 is listed in the FBH RCRA permit as SWMU #FBH6. At the request of EPA Region V in a June 16, 1994, regulatory review meeting, Building 422 has been removed from the EI program and added to the RFI program. A discussion of the investigation activities and analytical results for EI Site 2 (Roads and Grounds Vehicle Maintenance Shop, Building 422) have been moved to Section 4.2 of the Final Phase I RFI Report.

4.3 EI Site 3: Former Post Exchange (PX) Gasoline Station, Building 619

Building 619 is the former post exchange (PX) gasoline station. The investigation conducted at the site and the results of the investigation are discussed below.

4.3.1 Investigation Activities Performed

The investigation activities performed at Building 619 consisted of a records review, field screening, investigative sampling, monitoring well installation, and land surveying. These activities are discussed in the following subsections.

4.3.1.1 Records Review

When the gasoline station was in operation, POL was stored in 5 USTs at the site. These 5 USTs were removed in 1992 (Weston, 1992). POL contamination was identified at the site and remediation has been conducted. According to Tom Shafer, FBH Environmental Coordinator, remediation consists of excavating and disposing of petroleum-contaminated soil associated with the USTs under the state UST/LUST remediation program. Soil potentially contaminated with petroleum products (from past UST usage) was excavated from the area where the USTs were formerly located during January 1994. The COE provided oversight for this excavation, which was performed by ATEC Associates, the COE's subcontractor. However, potential contamination resulting from solvents and used oil from maintenance activities at the Former PX Gasoline Station, Building 619, was not addressed during the UST soil remediation effort.

4.3.1.2 Field Screening

Field screening activities consisted of collecting and analyzing investigation soil-gas samples, replicate samples, and collocated samples. The soil-gas survey of the site was conducted to screen the site for the absence or presence of VOCs in the subsurface soil. Initially, 19 soil-gas samples were to be collected from locations spaced at approximately 25-foot intervals around the perimeter of Building 619 and in paved and unpaved areas north and east of Building 619, as indicated in Figure 4.5. Two of the 19 soil-gas samples were to be collected along the first 50 feet of the sewer lateral from Building 619. In practice, soil-gas samples were collected at 14 locations at depths ranging from 3.5 to 6 feet bgs. At the remaining 7 sampling locations, the soil was of such low permeability that soil-gas samples could not be collected. Six of the 7 locations where samples were not collected are shown in Figure 4.5. One replicate and 1 collocated sample were also collected. Soil-gas samples were analyzed for VOCs.

4.3.1.3 Investigation Sampling

The field investigation sampling at Building 619 consisted of the following activities:

- Collection and analysis of 15 subsurface soil samples from 5 soil borings and 1 duplicate from 1 soil boring
- Collection and analysis of 1 round of groundwater samples

Soil and groundwater samples collected from this site were analyzed for VOCs and TPH. In addition, soil samples were analyzed for total metals. Samples were analyzed for VOCs and metals because automotive repair and maintenance activities involving the use of solvents and the storage of used oil are known to have occurred at this site. Samples were analyzed for TPH to assess the concentration of hydrocarbons not on the target analyte list that may be present in soil subjected to previous POL spills. The individual compounds included in these analytical suites are presented in Section 3.1.

A summary of Phase I sampling rationale and locations at the Former PX Gasoline Station, Building 619, is provided in Table 4.6. Field investigation activities performed at this site are described in more detail in the following sections.

Soil Borings and Subsurface Soil Sampling

Five soil borings (EI003SB001 through EI003SB005) were drilled to the water table to verify soil-gas survey results. The boring locations are shown in Figure 4.6. Boring locations were selected on the basis of topography, site history (as a gasoline station), soil-gas survey results, and the locations of underground utilities. These locations were revised from proposed locations shown in the TSP (HLA, 1993a). One boring was proposed to be sampled continuously to provide a complete lithologic description of the total depth explored. The 4 remaining borings were sampled at 5-foot intervals for descriptive purposes. In general, it was necessary to collect soil samples at intervals more closely spaced than those proposed in the TSP (HLA, 1993a) to accurately establish the depth at which groundwater was first encountered so that soil samples would not be collected beneath the water table. This was necessary because the flow of groundwater into borings during drilling was sometimes negligible to nonexistent due to the low permeability of the fine-grained materials being drilled. Three soil samples per boring were collected for chemical analysis at approximately 1 to

2 feet bgs, 4 to 5 feet bgs, and from soil immediately above the water table unless poor sample recovery precluded the collection of samples at these depths.

Soil samples were analyzed for VOCs, TPH, and total metals. Soil boring logs are presented in Appendix H.

Monitoring Well Installation and Groundwater Sampling

Four monitoring wells (1 upgradient [EI003MW003] and 3 downgradient [EI003MW001, EI003MW002, and EI003MW004]) were constructed during the Phase I field investigation at EI Site 3. Monitoring well locations are shown in Figure 4.6. These locations were selected on the basis of site topography (there is an approximately 15-foot drop in the ground surface elevation between Building 619 and the drainage channel located to the northeast), site history, and the results of the soil-gas survey at the site, and were revised from proposed locations shown in the TSP (HLA, 1993a). The groundwater flow direction was assumed to be toward the northeast, based on topography, and was confirmed by the results of the water-level survey conducted on February 14, 1994 (Plate 1).

Boring EI003SB002 was originally scheduled for conversion into a downgradient monitoring well. Because a saturated zone was not encountered during drilling, the boring was left "uncased" (with all but the upper 5 feet of augers removed) overnight to see if groundwater would accumulate in the boring. The following day, an electric water-level indicator was used to check for the presence of groundwater in the boring. Less than 0.1 foot of water was present in the boring, which was insufficient to set a monitoring well. Boring EI003SB002 was subsequently backfilled with a cement-bentonite grout and an alternative location for the well was selected. Boring EI003SB007 was drilled as an alternative downgradient monitoring well location. Because a saturated zone was not encountered during drilling, the boring was left "uncased" overnight (as was done for Boring EI003SB002) to see if groundwater would accumulate in the boring. The following day, less than 0.5 foot of water was present in the boring (which caved in approximately 2 feet overnight),

which was insufficient to set a monitoring well. Boring EI003SB007 was subsequently backfilled with a cement-bentonite grout and a second alternative location for the well was selected. Boring EI003MW002 was drilled as a second alternative downgradient monitoring well location. A saturated zone was encountered at this location during drilling and a monitoring well was constructed.

Monitoring Well EI003MW003 was originally constructed in Boring EI003SB003 located near the southeast side of Building 619. During soil remediation efforts overseen by the COE during January 1994, soil from the former UST pit was excavated to within approximately 2 feet of Well EI003MW003. Because of this, soil surrounding the well casing caved into the excavation, exposing the upper portion of the completed monitoring well, thus compromising the integrity of the surface seal. After the COE's subcontractor completed excavating soil from the former UST pit, the excavation was backfilled with a gravel fill material. The damaged monitoring well (EI003MW003) was subsequently abandoned on February 6, 1994, by overdrilling the well casing and backfilling the boring with cement-bentonite grout according to USAEC and IDEM standards.

A location for a replacement upgradient monitoring well was selected south of Building 619 (EI003SB03A). During drilling of Boring EI003SB03A, a saturated zone was not encountered. Based on previous drilling experience at this site, this boring was backfilled with a cement-bentonite grout. An alternate location for the upgradient monitoring well was selected and drilled (Boring EI0035SB03B). During drilling of Boring EI003SB03B, a saturated zone was encountered and the boring was intended to be converted to a monitoring well. After completion of drilling, the drillers encountered mechanical difficulties when their auger plug became disconnected from the end of the drill rod. The drillers were able to extract the auger plug but in doing so had to overdrill Boring EI003SB03B deeper than USAEC guidelines allowed for constructing a monitoring well at the planned completion depth. Subsequently, Boring EI003SB03B was backfilled with a cement-bentonite grout. A second alternative location for the upgradient monitoring well was selected

(EI003SB03C). During drilling of Boring EI003SB03C, a saturated zone was encountered and the boring was converted into Monitoring Well EI003MW003 on February 5, 1994.

The monitoring wells were installed to assess the shallow groundwater quality and flow direction at the site. Monitoring well construction diagrams are presented in Appendix H.

The monitoring wells were sampled once during Phase I to assess upgradient and downgradient shallow groundwater quality at the site. Groundwater samples were analyzed for VOCs and TPH. Monitoring well development and groundwater sampling procedures were revised from those proposed in Appendix A of the TSP (HLA, 1993a) because of the slow groundwater recharge rates of most wells as a result of the low permeability soil. A discussion of these revised procedures is presented in Section 3.0. When HLA personnel were performing presample purging and groundwater sampling of Well EI003MW002, they observed water seeping out of the ground surface approximately 10 feet away from the well. According to FBH personnel, the water was flowing from an underground water pipe that was cracked. The occurrence of water seeping from the ground was not observed during drilling and well installation.

4.3.1.4 Land Survey

All new monitoring wells installed at the Former PX Gasoline Station, Building 619, were surveyed for UTM x- and y-coordinates, latitude and longitude, and elevations in feet above NGVD by a licensed surveyor registered in the State of Indiana. Surveying procedures are discussed in Appendix A of the TSP (HLA, 1993a). Surveying data are presented on Plate 2.

4.3.2 Results of Investigation

The results of the investigation are discussed by media in the following sections. The analytical suites for each of the media are also discussed.

4.3.2.1 Field Screening Results (Soil-Gas Survey)

Soil-gas samples were collected at 14 locations at depths ranging from 3.5 to 6 feet bgs. The analytical results are summarized in Table 4.7 and presented in Figure 4.7. 1,1,1-TCA; PCE; toluene; ethylbenzene; xylenes; and TVH were all detected in the soil-gas samples. The VOCs detected include gasoline constituents and solvents used in vehicle maintenance.

4.3.2.2 Subsurface Soil Samples

Analytical results for metals detected at concentrations greater than background concentrations and detections of organics are summarized in Table 4.8. Analytical results for analytes for which background data are not available are summarized in Table 4.9. Figure 4.6 shows soil boring locations where the subsurface soil samples were collected at EI Site 3. Figure 4.8 shows the analytical results of subsurface soil samples collected at this site that exceed the IDEM background concentrations, or where detections of organic compounds were reported.

Metals

Metals concentrations exceeding IDEM background concentrations were detected in 1 or more of the subsurface soil samples collected from the 5 soil borings sampled at EI Site 3. Sixteen metals exceeded IDEM background concentrations for subsurface soil samples collected at EI Site 3, and ranged from 10 metals in subsurface soil samples from Boring EI003SB004 (1.0-, 5.0-, and 11.0-foot depths) to 14 metals in subsurface soil samples from Boring EI003SB001 (1.0-, 5.0-, and 9.0-foot depths). Of the 16 metals exceeding IDEM background in subsurface soil samples from EI Site 3, lead was the most frequent metal, with 15 detections exceeding IDEM background. Except for Boring EI003SB004, all of the samples were collected from native soil.

Although lead is a naturally occurring element, lead compounds were also historically added to gasoline. Its occurrence at the site could be related to the occurrence of organic gasoline constituents. The highest concentrations of lead were detected in subsurface soil samples from Boring EI003SB002 (1-foot depth) at 87.5 mg/kg and in a subsurface soil sample from Boring

EI003SB001 (6.5-foot depth) at 88.1 mg/kg. (These 2 borings are located northeast and downslope of Building 619.) However, lead concentrations, while exceeding IDEM background, were well below the EPA's 400 mg/kg lead criteria (EPA, 1994c). Other metals detected in subsurface soil samples at concentrations above IDEM background are naturally occurring elements and their presence does not appear to be related to known site activities.

Organics

Organic compounds, including several TICs, were detected in subsurface soil samples collected from 2 of the 5 soil borings sampled at EI Site 3. Twelve VOCs and TPH were detected in the subsurface soil samples collected at EI Site 3. Most of the organic compounds are gasoline constituents identified in fill material collected from Boring EI003SB003. TPH was detected in soil samples collected from Soil Borings EI003SB001, EI003SB003, and EI003SB005. TPH concentrations at 5.5 feet in Soil Boring EI003SB001 exceeded the IDEM action levels for TPH. Soil Boring EI003SB003 is located in an area from which USTs were removed, and the presence of these analytes is likely related to the USTs formerly at this site.

Acetone was detected in 1 sample from Boring EI003SB005. Acetone is a common laboratory solvent, and this detection is probably the result of laboratory contamination.

4.3.2.3 Groundwater Samples

Based on known site history, groundwater samples were analyzed for VOCs and TPH at EI Site 3 (HLA, 1993a). Table 4.10 presents a summary of the analytical results for analytes detected in the groundwater samples. Figure 4.6 shows the locations of the monitoring wells where the groundwater samples were collected at EI Site 3. Figure 4.8 shows the analytical results of detected organics in the groundwater samples collected at this site.

On the basis of the site topography, groundwater flow direction was anticipated to be toward the northeast. This assumption was confirmed by the water-level survey conducted on February 14, 1994 (Plate 1).

Organics

Chloroform was the only organic compound detected in groundwater samples collected at EI Site 3. Chloroform was detected only in the groundwater sample collected from downgradient Well EI003MW002, at a concentration of 4.30 μg/l (Table 4.10). Its occurrence is not related to known activities at the site. However, chloroform is a trihalomethane compound frequently detected in drinking water as a result of the chlorination process (AWWA Research Foundation, 1983). Its presence may indicate a leaking water-supply line. As indicated in Section 4.3.1.3, a suspected water-supply line leak was noted near Well EI003MW002 during purging.

4.3.3 Conclusions

Based on the investigation sampling and the results of the investigation at EI Site 3, the following conclusions have been made:

- Soil-gas results indicated the detection of 5 VOCs at low concentrations.
- Subsurface soil metals concentrations exceeded IDEM background concentrations in samples from 4 of the 5 borings drilled at the site. With the possible exception of lead, the occurrence of metals exceeding IDEM background is not related to site activities.
- Lead was the most frequently detected metal in subsurface soil in concentrations exceeding IDEM background. Although organic lead compounds were historically added to gasoline, lead concentrations were detected below the EPA lead screening levels.
- Organic compounds were detected in subsurface soil samples collected from 3 soil borings. Most organic compounds detected are gasoline constituents identified in a sample of fill material collected at a former UST site.
- TPH (diesel) concentrations detected at 5.5 feet in Boring EI003SB001 exceeded the IDEM action level for TPH in soil.
- Chloroform was detected by the laboratory in 1 groundwater sample. The occurrence of chloroform is unrelated to known site activities.

4.3.4 Recommendations

Phase II activities recommended for this site include additional sampling, background evaluation, and risk assessment as described below:

- Groundwater should be resampled for VOCs to confirm the Phase I analytical results because VOCs identified in soil-gas and subsurface soil samples were not identified in groundwater.
- A risk assessment should be performed for any identified chemicals of concern following sampling and reassessment of background conditions.
- The Army should consult with IDEM UST personnel to assess whether additional investigation related to USTs is required because the TPH (diesel) concentration in 1 sample in Soil Boring EI003SB001 exceeded the IDEM action level for TPH in soil. (This sample was collected downgradient with respect to topography and groundwater from the former UST site.)

4.4 EI Site 4: Directorate of Installation Support (DIS) Engineering/ Maintenance, Building 26

DIS Engineering/Maintenance currently operates in Building 26 (Figure 4.9). Maintenance facilities include the following:

- A carpentry shop
- An electrical shop
- A preventive maintenance shop
- A heating and air conditioning shop

4.4.1 Investigation Activities Performed

The investigation activities performed at Building 26 consisted of a records review, field screening, investigation sampling, monitoring well installation, and land surveying. These activities are discussed in the following subsections.

4.4.1.1 Records Review

Most DIS maintenance activities were performed at the job site. However, some maintenance activities were conducted at Building 26. Painting, sanding, varnishing, and other carpentry activities were performed in the carpentry shop. Used paint thinner, asbestos, and asphalt coating

have been stored at the carpentry shop in the past. Electrical shop activities included transferring PCB-containing equipment to secure storage locations. Electrical transformers were previously stored at the electrical shop in the northwest corner of Building 26 (Weston, 1992). Work performed by the preventive maintenance shop included painting and minor repairs to plumbing fixtures. The heating and air conditioning shop stored acids, bases, used petroleum naphtha, phosphates, biocides in solution, and other chemicals used in maintenance operations. At one time, DIS operated a metal and paint shop in Building 26. Small amounts of acids, bases, paint strippers and thinners, and alcohols were stored at the paint shop.

4.4.1.2 Field Screening

Field screening activities consisted of collecting and analyzing 19 investigation, 2 replicate, and 1 collocated soil-gas samples. Thirty-two surface soil samples were also collected and screened for the presence of PCBs.

Soil-Gas Survey

A soil-gas survey was conducted to screen the site for the absence or presence of the volatile fraction of solvents or POL in the subsurface soil. Initially, 32 soil-gas samples were to be collected from locations spaced at approximately 25-foot intervals around the perimeter of Building 26. Two soil-gas samples were to be collected along the first 50 feet of the sewer lateral from Building 26. During the soil-gas survey, soil-gas samples were collected at 14 locations at depths ranging from 3 to 6 feet. In the remaining 20 locations, the soil was of such low permeability that soil-gas samples could not be collected. Five additional samples were collected to further delineate the extent of detected VOCs. Soil-gas sampling procedures are discussed in Appendix A of the TSP (HLA, 1993a).

Polychlorinated Biphenyl Soil Screening

Twenty-eight surface soil samples were collected at locations spaced at approximately 25- to 50-foot intervals around the perimeter and north of Building 26 as shown in Figure 4.10. Soil samples were collected from approximately 0.0 to 0.5 feet bgs. These samples were screened for PCBs in the field

and were not submitted to a laboratory for chemical analysis with the exception of 3 of the PCB screening samples, which were submitted to the laboratory for chemical analysis to verify PCB screening results. Soil sample PCB field screening procedures are discussed in Appendix A of the TSP (HLA, 1993a).

4.4.1.3 Investigation Sampling

The Phase I field investigation at DIS Engineering/Maintenance, Building 26, consisted of the following activities:

- Collection and analysis of 15 subsurface soil samples from 5 soil borings and 2 duplicate subsurface soil samples from 2 soil borings
- Collection and analysis of 1 round of groundwater samples for 4 monitoring wells and 1 round of duplicate samples for 1 monitoring well

Soil and groundwater samples collected from this site were analyzed for VOCs, SVOCs, TPH, and total metals. In addition, groundwater samples were analyzed for dissolved metals. Samples were analyzed for VOCs, SVOCs, TPH, and metals because a variety of organic and inorganic chemicals were used for the maintenance activities conducted at this site. The samples collected at this site were analyzed for PCBs because PCB-containing equipment was stored at this site. Although the SVOC analytical method could detect PCBs and other compounds, PCBs were analyzed separately using a method that is more sensitive than the SVOC analytical method. The individual compounds included in these analytical suites are presented in Section 3.1.

A summary of Phase I sampling rationale and locations at DIS Engineering/Maintenance Building 26 are provided in Table 4.11. Field investigation activities performed for this site are described in greater detail in the following sections.

Soil Boring and Subsurface Soil Sampling

Five soil borings (EI004SB001 through EI004SB005) were drilled to the water table to verify soil-gas survey results. The boring locations are shown in Figure 4.11. Boring EI004SB002 was located near

the sewer lateral from Building 26. Boring locations were selected on the basis of soil-gas survey results, site conditions, and locations of underground utilities. These locations were revised from proposed locations shown in the TSP (HLA, 1993a). One boring was proposed to be sampled continuously to provide a complete lithologic description of the total depth explored. The 4 remaining borings were to be sampled at 5-foot intervals for descriptive purposes. However, it was necessary to collect soil samples at intervals more closely spaced than those proposed in the TSP (HLA, 1993a) to accurately establish the depth at which groundwater was first encountered, so that soil samples would not be collected beneath the water table. This was necessary because the flow of the groundwater into borings during drilling was sometimes negligible to nonexistent due to the low permeability of the fine-grained materials being drilled. Three soil samples per boring were collected for chemical analysis at 1 to 2 feet bgs, 5 to 6 feet bgs, and from soil immediately above the water table unless poor sample recovery precluded the collection of samples at these depths.

Soil samples were analyzed for VOCs, SVOCs, TPH, and total metals. Soil boring logs are presented in Appendix H.

Monitoring Well Installation and Groundwater Sampling

Four monitoring wells (1 upgradient [EI004MW001] and 3 downgradient [EI004MW002, EI004MW003, and EI004MW004]) were installed during the Phase I field investigation at DIS Engineering/Maintenance, Building 26. Monitoring well locations are shown in Figure 4.11. These locations were revised from proposed locations shown in the TSP (HLA, 1993a) on the basis of assumed groundwater flow direction, accessibility, the locations of utilities, and the results of the soil-gas survey. Groundwater flow direction was assumed to be toward the northwest. The monitoring wells were installed to assess the shallow groundwater quality and flow direction at the site. Monitoring well construction diagrams are presented in Appendix H.

The monitoring wells were sampled once during Phase I to assess upgradient and downgradient shallow groundwater quality at the site. Groundwater samples were analyzed for VOCs, SVOCs, TPH, and total and dissolved metals. Monitoring well development and sampling procedures were revised from those proposed in Appendix A of the TSP (HLA, 1993a) because of the slow groundwater recharge rates of most wells as a result of the low permeability soil. A discussion of these revised procedures is presented in Section 3.0.

4.4.1.4 Land Survey

All new monitoring wells installed at Building 26 were surveyed for UTM x- and y-coordinates, latitude and longitude, and elevations in feet above NGVD by a licensed surveyor registered in the State of Indiana. Surveying procedures are discussed in Appendix A of the TSP (HLA, 1993a). Surveying data are presented on Plate 2.

4.4.2 Results of Investigation

The results of the investigation are discussed by media in the following sections. The analytical suites for each of the media are also discussed.

4.4.2.1 Field Screening Results

Field screening results at EI Site 4 consisted of the results of analyses for 19 investigation soil-gas samples, 2 replicate samples, and 1 collocated sample, and PCBs screening analyses for 32 surface soil samples. The results are discussed individually below.

Soil-Gas Survey

Soil-gas samples were collected at 19 locations at depths of 3 to 6 feet bgs. Chloroform; TCE; PCE; 1,1,1-TCA; total 1,2-dichloroethene (1,2-DCE); vinyl chloride; toluene; ethylbenzene; xylenes; and TVH were all detected in the soil-gas samples. The constituents identified include chlorinated and nonchlorinated solvents as would be expected with the maintenance activities associated with the site. The sampling depths and analytical results are summarized in Table 4.12 and presented in Figure 4.12.

Polychlorinated Biphenyl Surface Soil Screening

Soil samples collected from EI Site 4 tested negative (screening results indicated less than 5 mg/kg) for PCBs (see Appendix B). The surface soil samples selected for PCB screening were collected either from soil immediately below the asphalt of the paved parking lot of EI Site 4 or from surface soil on the periphery of the paved areas (Figure 4.10). Three soil samples collected from the site were submitted to ESE for confirmation analysis of PCBs. Results of the laboratory analysis indicated that PCBs were present in 1 of the 3 confirmation samples at a concentration less than the concentration that could be detected by the PCB screening test. The maximum concentration detected by the ESE analysis for EI Site 4 samples was 0.0763 mg/kg. This concentration is below the EPA (1990a) residential action level of 1 ppm in soil. The results of the laboratory analysis of the confirmation samples were, therefore, in agreement with the results of the PCB screening test (Table 4.13).

4.4.2.2 Surface Soil Samples

Organics

The soil samples submitted for confirmation testing of PCBs were also analyzed for pesticides. Several pesticides with concentrations less than 0.1 mg/kg and one PCB (PCB 1260 [0.0763 mg/kg]) were detected in this sample (Table 4.13). These pesticides are probably the result of using pesticides at this site to control insects.

4.4.2.3 Subsurface Soil Samples

Analytical results for metals detected at this site that exceeded IDEM background concentrations are summarized in Table 4.14. Analytical results for analytes that do not have associated background data are summarized in Table 4.15. Figure 4.11 shows soil boring locations where the subsurface soil samples were collected at EI Site 4. Figure 4.13 shows the analytical results of subsurface soil samples collected at this site that exceeded the IDEM background concentrations or where detections of organics were reported.

Metals and Additional Analytes

Metals concentrations exceeding IDEM background were detected in subsurface soil samples from all five soil borings sampled at EI Site 4. Seventeen metals and cyanide exceeded IDEM background concentrations for subsurface soil samples collected at EI Site 4. The number of metals detections exceeding IDEM background subsurface soil concentrations ranged from 7 in subsurface soil samples collected from Boring EI004SB001 (3.0-, 5.0-, and 7.0-foot depths) to 12 in subsurface soil samples collected from Boring EI004SB005 (1.0-, 5.0-, 5.5-, and 17.5-foot depth). Eleven metals (and cyanide) were detected at concentrations exceeding IDEM background in Boring EI004SB002 (1.0-, 5.0-, 12.5-, and 17.5-foot depth). Of the 17 metals exceeding IDEM background subsurface soil concentrations in subsurface soil samples from EI Site 4, thallium and manganese were the most frequently detected metals with 12 and 10 detections, respectively.

Although some of the metals identified as exceeding IDEM background are used as pigments in painting, the occurrence of metals exceeding background appears not to be related to site activities. One or more metals exceeding IDEM background were identified in all subsurface soil samples at the site, suggesting the metals may occur naturally.

Organics

Organic compounds were detected at low concentrations in subsurface soil samples from each of the 5 soil borings sampled at EI Site 4 (Table 4.15). Seven organic compounds were detected in the respective subsurface soil samples. Each compound was detected at a concentration of less than or equal to 1.0 mg/kg. Di-N-butyl phthalate was the most frequently detected organic compound with 10 detections in subsurface soil samples collected from 4 of the 5 soil borings. PCE was detected in 1 soil sample (Boring EI004SB003; 6.0-foot depth), and TCE was detected in 3 subsurface soil samples from Boring EI004SB002 (1.0-, 5.0-, and 17.5-foot depths). PCE and TCE concentrations were equal to or less than 1 mg/kg. The presence of chlorinated solvents in the subsurface may be related to site activities; however, acetone and di-N-butylphthalate are common laboratory artifacts.

Tetradecone, a hydrocarbon, was detected as a TIC in one soil sample. TPH was detected in one soil sample collected from soil Boring EI004SB002 (1-foot depth). The concentrations identified are below the IDEM action level for TPH in soil at UST sites.

4.4.2.4 Groundwater Samples

Analytical results from groundwater samples were evaluated using two methods. First, groundwater analytical data for metals were compared to IDEM background concentrations (Table 4.16) and organic compounds detected in groundwater samples were reported (Table 4.17). Second, analytes detected above reporting limits in groundwater samples from the upgradient well (EI004MW003) were compared to analytes detected above reporting limits in groundwater samples from the downgradient wells (EI004MW001, EI004MW002, and EI004MW004) at EI Site 4. Figure 4.11 shows the locations of the monitoring wells where groundwater samples were collected at EI Site 4. Figure 4.14 shows the analytical results of groundwater samples collected at this site that exceed the provided background concentrations or where organic compounds were detected.

Upgradient and downgradient wells were identified on the basis of water-table elevations presented on the water-table elevation map (Plate 1). Regional groundwater flow is generally toward the northwest. In the vicinity of EI Site 4, the direction of groundwater flow is locally variable based on the interpretation of the water-table configuration (Plate 1). Based on HLA's interpretation, groundwater flow is southwest at this site. This pattern is inconsistent with the regional flow pattern.

Metals

Total and dissolved metals concentrations that exceeded IDEM background were detected in the groundwater samples collected from the 4 monitoring wells at EI Site 4 (Table 4.16). Twelve metals exceeding IDEM background groundwater concentrations were detected in groundwater samples collected from the 4 monitoring wells at EI Site 4. The number of metals exceeding IDEM background ranged from 5 in the groundwater samples collected from Well EI004MW004 to 12 in the groundwater sample collected from Well EI004MW003. Arsenic (total) and sodium (total and

dissolved) were detected in the 4 groundwater samples and were the metals most frequently detected in groundwater samples at concentrations exceeding IDEM background. Total and dissolved iron and manganese concentrations exceeded the respective drinking water secondary MCLs of 300 and 50 μg/l. Moreover, in the sample (EI004MW003), lead exceeded the 15 μg/l maximum concentration recommended for drinking water.

Filtered and unfiltered samples were analyzed to provide information on total and dissolved metals concentrations. When the reported filtered and unfiltered concentrations are similar (e.g., sodium), the metal occurs in the sample as a dissolved constituent. When unfiltered concentrations exceed filtered concentrations, sediment in the sample contributes to the metals concentrations. Concentrations exceeding IDEM background concentrations for antimony, chromium, copper, etc., may be related to suspended sediment in the sample.

The metals concentrations observed appear not to be related to known site activities. The highest observed concentrations for 10 metals (antimony [filtered], arsenic, chromium, copper, iron, lead, manganese, nickel, vanadium, and zinc) occur in the upgradient well (EI004MW003).

Organics

Organic detections were reported for groundwater samples collected from each of the 4 monitoring wells at the EI Site 4 (Table 4.18). For the duplicate analysis performed on the groundwater sample from Well EI004MW001, the volatile compound chloromethane was detected at 3.1 μg/l but was not detected in the original sample. Chloromethane is used as a refrigerant or local anesthetic, and its presence in the groundwater sample is not likely related to site activities.

Groundwater samples from 3 wells have detections of SVOCs, with bis(2-ethylhexyl)phthalate being the most frequently detected. Bis(2-ethylhexyl)phthalate is a common laboratory contaminant, and

the laboratory indicated that this compound was also found in the associated laboratory method blanks.

Cyclohexanol reported in the groundwater Sample EI004MW004 is a TIC detected at 20 $\mu g/l$. Cyclohexanol can be used as part of a resin solvent or in the use of insecticides. The presence of these organic compounds in the groundwater samples from the EI Site 4 may be related to an adjacent site (Pesticide and Mixing Storage Area, Building 27). However, the TIC identification is not certain.

4.4.3 Conclusions

Based on the results of the investigation at EI Site 4, the following conclusions have been made:

- Ten VOCs (chlorinated and nonchlorinated solvents) were detected in various soil-gas samples from 19 locations.
- PCB field screening samples on surface soil tested negative. A low PCB detection (less than the 1 mg/kg EPA residential action level in soil and less than the detection limit of the screening method) was reported in a laboratory confirmation sample.
- Low concentrations of pesticides were reported in 1 surface soil sample.
- Subsurface soil metals concentrations exceeded IDEM background concentrations in samples from all 5 borings. Seventeen metals and cyanide were detected above IDEM background, with thallium and manganese occurring most frequently. The occurrence of metals exceeding IDEM background is not related to known site activities.
- Subsurface soil detections of organics were reported in samples from all 5 borings. TCE and PCE each were detected in samples at concentrations of less than 1 mg/kg, and may be related to site cleaning and maintenance activities.
- Groundwater metals concentrations exceeded IDEM background concentrations in all 4 monitoring wells at EI Site 4. The highest concentrations for 10 of 12 metals exceeding background were reported in the upgradient well (EI004MW003).
- Groundwater detections of organics were reported for all 4 wells. However, compounds detected were either present in laboratory blanks, were not detected consistently, or were TICs.

4.4.4 Recommendations

Phase II activities recommended for this site include additional sampling, background evaluation, and risk assessment as described below:

- Additional surface and subsurface sampling should be performed to evaluate the extent of pesticide contamination at this area because several pesticides were identified in a surface soil sample collected in the northwest corner of the site.
- Additional groundwater samples should be analyzed for pesticides.
- Groundwater should be resampled for VOCs to confirm the Phase I analytical results because VOCs identified in soil-gas and subsurface soil samples were not identified in groundwater.
- Groundwater flow direction should be reevaluated prior to sampling because the reported groundwater flow is inconsistent with regional patterns and cannot be explained by local topographic controls.
- A risk assessment should be performed for chemicals of concern identified at this site following sampling and reassessment of background concentrations.

4.5 EI Site 5: Electrical Shop, Building 4

Transformers containing PCB oil were repaired at the Electrical Shop, Building 4. PCB-containing waste storage was formerly located next to Building 4.

4.5.1 Investigation Activities Performed

The investigation activities performed at Building 4 consisted of a records review, PCB field screening, and investigation sampling. These activities are discussed in the following subsections.

4.5.1.1 Records Review

A diesel-powered electrical generating facility was formerly located in an area south of Building 4. The foundations for these generators are still present at the site. A diesel fuel leak from a supply line leading to the electric generators was reported in 1978 (Weston, 1992). An estimated 178 gallons of diesel fuel leaked onto the ground surface. In response, approximately 20 cubic yards of diesel fuel-contaminated soil were excavated and stockpiled for eventual disposal in an approved landfill. No additional information was available concerning this incident (Weston, 1992).

Reportedly, an oil/water separator was located adjacent to Building 4 on the north side (Weston, 1992). Runoff from the diesel generators and diesel storage tank area was discharged to the oil/water separator. In 1978, discharge from the oil/water separator overflowed into the storm sewers, discharging approximately 150 gallons of diesel fuel to Lawrence Ditch and subsequently to Fall Creek. An oil odor and taste was detected in the public water-supply effluent from the Fall Creek Plant of the Indianapolis Water Company. Booms were used along Fall Creek to remove the visible oil from the stream (Weston, 1992). Weston was unable to verify the existence of the oil/water separator adjacent to Building 4 and, therefore, did not include this site in the summary of sites having wash racks, grease racks, or oil/water separators (Weston, 1992; Table 3-3). This oil/water separator is included in the records review of wash racks, grease racks, and oil/water separators included in the Phase I RFI Final Report (HLA, 1994b).

4.5.1.2 Field Screening (PCB Surface Soil Screening)

Twenty-one surface soil samples were collected for PCB screening from areas located east and south of Building 4, as shown in Figure 4.15. Soil samples were collected from the surface to approximately 0.5 foot bgs. These samples were screened for PCBs in the field, and 2 of the PCB screening samples were submitted to the laboratory for chemical analysis to verify PCB screening results. A soil-gas survey was not conducted at this site because the soil contaminated with diesel fuel was removed before this EI was performed.

4.5.1.3 Investigation Sampling

The investigation sampling performed at Building 4 consisted of the following:

- Collection and analysis of 5 surface soil samples
- Collection and analysis of 15 subsurface soil samples from 5 soil borings

Surface soil samples collected from this site were analyzed for TPH. Subsurface soil samples were analyzed for TPH and PCBs. Samples were analyzed for TPH to assess the concentration of hydrocarbons, not on the target analyte list, that may be present in soil subjected to previous POL

spills. Because PCB-containing equipment was stored at this site, samples were analyzed for PCBs. The individual compounds included in these analytical suites are presented in Section 3.1.

A summary of Phase I sampling rationale and locations at the Electrical Shop, Building 4 are provided in Table 4.19. Field investigation activities performed for this site are described in more detail in the following sections.

Surface Soil Sampling

Five surface soil samples were collected to assess the potential for contamination in the vicinity of the former diesel-powered generators located south of Building 4. Surface soil sampling locations were revised from proposed locations shown in the TSP (HLA, 1993a) based on the layout of the concrete pads where the former diesel generators were located. Surface soil sampling locations are shown in Figure 4.16. Surface soil samples were analyzed for TPH.

Soil Borings and Subsurface Soil Sampling

A total of 5 soil borings (EI005SB001 through EI005SB005) were drilled and sampled to assess the potential for subsurface soil contamination in transformer storage areas and in the vicinity of the former diesel-powered generators located south of Building 4. The soil boring locations are shown in Figure 4.16. Boring locations were selected on the basis of the PCB soil screening results and observations made in the field based on historical and/or current site use, and were revised from proposed locations shown in the TSP (HLA, 1993a).

Originally, 3 of the 5 soil borings were to be drilled to approximately 10 feet bgs, and 2 of the 5 soil borings were to be drilled to the water table. Because groundwater was encountered during drilling at depths ranging from between 6 and 7 to 10.75 feet bgs, the deepest boring (targeted to the water table) was drilled to a depth of 11 feet bgs. Borings EI005SB001, EI005SB002, and EI005SB005 were located where PCB concentrations were highest on the basis of PCB field screening results. Soil samples from the borings were collected continuously. It was necessary to collect soil samples at

intervals more closely spaced than those proposed in the TSP (HLA, 1993a) to accurately establish the depth at which groundwater was first encountered during drilling, so that soil samples would not be collected below the water table. This was necessary because the flow of groundwater into borings during drilling was sometimes negligible to nonexistent due to the low permeability of the fine-grained materials being drilled. Continuously sampled borings also provide a complete lithologic description of the total depth drilled. Three soil samples per boring were collected for chemical analysis at approximate depths of 1 to 2 feet bgs, 4 to 5 feet bgs, and from soil immediately above the water table unless poor sample recovery precluded the collection of samples at these depths. Subsurface soil samples were analyzed for PCBs and TPH. Soil boring logs are presented in Appendix H.

4.5.2 Results of Investigation

The results of the investigation are discussed by media in the following sections. The analytical suites for each of the media are also discussed.

4.5.2.1 Field Screening Results (PCB Surface Soil Screening)

Soil samples collected from EI Site 5 tested negative when screened for PCBs with the exception of samples collected from locations identified as EI005PCB10, EI005PCB12, and EI005PCB13. A surface soil sample collected from each of these locations tested positive for containing greater than 5 mg/kg, but less than 50 mg/kg of the reference PCB 1248.

4.5.2.2 Surface Soil Samples

The analytical results indicated that organic analytes were not detected in surface soil samples, with the exception of the analytes detected in the PCB screening confirmation samples (Table 4.20). Figure 4.16 shows the locations where surface soil samples were collected at EI Site 5. Figure 4.17 shows the analytical results of surface soil samples collected at this site that exceed background concentrations.

Organics

Two PCB-screening surface soil samples were submitted to ESE for confirmatory PCB analyses, and 5 additional surface soil samples were submitted for TPH analyses (see Appendix B and Figure 4.15). Results of the laboratory analyses indicated that Sample EI005PCB10 contained 0.590 mg/kg of PCB-1260 and 0.00601 mg/kg of gamma-chlordane (a pesticide). Laboratory results for Sample EI005PCB13 indicate the presence of 0.0143 mg/kg of delta-benzene hexachloride (a pesticide). No PCBs were identified above detection limits in this sample. The pesticides are probably related to the basewide use of pesticides to control insects. The concentrations of PCBs in the confirmatory soil samples were below the 1 mg/kg residential action level.

4.5.2.3 Subsurface Soil Samples

Analytical results for pesticide/PCB and TPH analytes detected at concentrations greater than background subsurface soil concentrations are summarized in Table 4.21. Figure 4.16 shows soil boring locations where the subsurface soil samples were collected at EI Site 5. Figure 4.17 shows the analytical results of subsurface soil samples collected at this site that exceeded background concentrations or where detections of organic compounds were reported.

Organics

PCBs were not detected in subsurface soil samples. However, 2 compounds included in the pesticides/PCBs analyte list were detected in 1 subsurface soil sample collected from Boring EI005SB002 (2.5-foot depth). The compounds detected (Table 4.21) were 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT) (0.0185 mg/kg) and 2,2-bis(p-chlorophenyl)-1,1-dichloroethene (DDE) (0.01 mg/kg) and are likely present as a result of the historic basewide application of DDT to control insects.

TPH (diesel fuel) was detected in two soil samples from Boring EI005SB003 at depths of 2 and 4 feet at concentrations ranging from 20 to 520 mg/kg. Boring EI005SB003 is located near the former location of the diesel-powered generators and its presence in the subsurface soil samples may be

related to previous site activities. However, TPH was not detected in a subsurface soil sample collected below these 2 samples. Although not directly applicable to this site, the TPH concentrations in the soil sample collected at a depth of 4 feet exceeded IDEM TPH soil action levels for USTs.

4.5.3 Conclusions

Based on the investigation sampling and the results of the investigation at EI Site 5, the following conclusions have been made:

- PCB screening of surface soil indicated three detections of PCBs at concentrations greater than 5 mg/kg, but less than 50 mg/kg. Confirmatory laboratory analysis indicated confirmation of PCBs at a concentration of less than the 1 mg/kg action level for soil in residential areas.
- Low concentrations of pesticides were identified in 2 surface soil samples submitted for confirmatory analysis. The pesticides are probably related to the basewide use of pesticides.
- The pesticides DDT and DDE were identified in 1 subsurface soil sample. The pesticides are probably related to the basewide use of pesticides.
- TPH (diesel fuel) was detected in subsurface soil samples collected from 1 boring. The TPH concentration in 1 sample exceeded the IDEM action level for TPH in soil at UST sites.

4.5.4 Recommendations

Additional Phase II activities recommended for this site consist of additional investigative sampling as described below:

- Additional sampling should be conducted to evaluate the extent of TPH at the site and to evaluate whether groundwater has been affected because TPH concentrations in a subsurface soil sample exceeded the IDEM action level for TPH in soil at UST sites.

4.6 EI Site 6: Former Coal Storage Yard, Building 2

The Former Coal Storage Yard is northeast of Building 2 (the Heating Plant). The yard was used to store several hundred tons of coal in an outdoor pile on an approximately 1-acre uncovered concrete pad. Coal use was discontinued in 1989, when the Heating Plant was converted to natural gas. During wet weather, the coal stored at the yard reportedly produced a sludge that flowed onto the

concrete pad and into the storm drains and a nearby settling/evaporation basin. Runoff from the former coal pile is a concern because it could create abnormal soil pH and metals contamination.

4.6.1 Investigation Activities Performed

The investigation activities performed at the Former Coal Storage Yard consisted of a records review, and surface and subsurface soil investigation sampling. These activities are discussed in the following subsections.

4.6.1.1 Records Review

In 1990, the AEHA conducted a soil investigation in the vicinity of the Former Coal Storage Yard. Four shallow soil borings were drilled and sampled around the perimeter of the concrete coal storage pad. Soil samples were collected from approximately 0.5 to 2.5 feet bgs. Analytical results of the soil samples indicated the presence of chromium and arsenic at concentrations higher than in the background sample (Borehole No. 1), as shown in the table below.

Borehole No.	Analytes							
	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury
1	3.13	106	1.10	30.5	21.200	36.2	732	0.039
2	17.6	53.1	ND	33.6	22.100	12.3	84.6	0.019
3	6.56	72.0	ND	179	24.200	18.3	425	0.030
4	4.05	104	0.640	156	24.500	15.1	308	0.040

Source: AEHA, 1990.
Concentrations in milligrams per kilogram.

ND Not detected above the analytical detection limit

4.6.1.2 Investigation Sampling

The field investigation sampling at the Former Coal Storage Yard, Building 2, consisted of the following activities:

- Collection and analysis of 10 surface soil samples and 1 duplicate surface soil sample
- Collection and analysis of 10 subsurface soil samples from 10 soil borings

Soil samples collected from this site were analyzed for pH and total metals, which were recommended for analysis in the Enhanced PA (Weston, 1992). Samples were analyzed for pH and metals because of the potential movement of metals in runoff from the coal pile. The individual compounds included in these analytical suites are presented in Section 3.1. However, the need for analysis of PAHs in soil may need to be evaluated because of the history of coal storage at the site.

A summary of the Phase I sampling rationale and locations at the Former Coal Storage Area, Building 2, is provided in Table 4.22. Figure 4.18 illustrates the Former Coal Storage Area sampling locations. Field investigation activities performed at this site are described in greater detail in the following sections.

Surface Soil Sampling

Ten surface soil samples (EI006SS001 through EI006SS010) were collected from previously unsampled areas surrounding the former concrete coal storage pad and from the wetlands area located east and southeast of the concrete pad, as shown in Figure 4.18. Samples were collected from approximately 0.0 to 0.5 foot bgs.

Soil Borings and Subsurface Soil Sampling

Seven soil borings (EI006SB001 through EI006SB007) were drilled using a hand auger to a depth of approximately 3 feet bgs at the same locations as the surface soil samples around the perimeter of the concrete coal storage pad. An additional 3 soil borings (EI006SB008 through EI006SB010) were located east of the concrete pad in the wetlands area, as shown in Figure 4.18. One soil sample per boring was collected for chemical analysis from a depth of approximately 2 to 3 feet bgs. Soil boring logs are presented in Appendix H.

4.6.2 Results of Investigation

The results of the investigation are discussed by media in the following sections. The analytical suites for each of the media are also discussed.

4.6.2.1 Surface Soil Samples

Analytical results for metals detected at concentrations greater than IDEM background surface soil concentrations and the soil pH are summarized in Table 4.23. Figure 4.18 shows the locations where surface soil samples were collected at EI Site 6. Figure 4.19 shows the analytical results of surface soil samples collected at this site that exceed provided background concentrations.

Metals and Additional Analytes

Metals concentrations that exceeded IDEM background surface soil concentrations were detected in each of the 10 surface soil samples collected at EI Site 6. Seventeen metals exceeded IDEM background concentrations for surface soil samples collected at EI Site 6. The number of metals detections exceeding IDEM background surface soil concentrations ranged from 1 in surface soil Sample EI006SS006 to 14 in surface soil Sample EI006SS004. Soil pH was slightly to moderately alkaline, ranging from 7.33 to 8.24.

Of the 17 metals exceeding background concentrations in surface soil samples from EI Site 6, selenium, thallium, and zinc were the most frequently detected above background. The presence of metals in the surface soil may be related to previous site activities. However, these metals are naturally occurring elements, and in many instances, sample concentrations only slightly exceed IDEM background values.

4.6.2.2 Subsurface Soil Samples

Analytical results for metals detected in subsurface soil samples at concentrations greater than background and the soil pH are summarized in Table 4.24. Analytical results for analytes that do not have associated background data are summarized in Table 4.25. Figure 4.18 shows soil boring locations where the subsurface soil samples were collected at EI Site 6. Figure 4.20 shows the analytical results of subsurface soil samples collected at this site that exceed IDEM background concentrations.

Metals and Additional Analytes

Metals concentrations exceeding IDEM background subsurface soil concentrations were detected in subsurface soil samples from 7 of the 10 soil borings sampled at EI Site 6. Four metals exceeded IDEM background concentrations for subsurface soil samples collected at EI Site 6. The metals detected in subsurface soil samples exceeding IDEM background concentrations included arsenic, beryllium, selenium, and sodium. Cyanide was detected at a concentration exceeding IDEM background concentrations in just 1 subsurface soil sample (EI006SB005) collected at EI Site 6. Soil pH was neutral to slightly alkaline, ranging from 7 to 8.

Arsenic was detected at a concentration of 35 mg/kg. Beryllium was detected at concentrations ranging from 1.14 mg/kg to 1.53 mg/kg. Selenium was detected at concentrations ranging from 0.353 mg/kg to 0.604 mg/kg. Sodium was detected at concentrations ranging from 429 mg/kg to 733 mg/kg. Of the 4 metals detected in subsurface soil samples from EI Site 6 exceeding IDEM background concentrations, sodium and selenium were the most frequently detected metals with 6 and 5 detections, respectively. Sodium, however, is a commonly occurring metal with little or no effect on the environment. Spatially, metals were detected on all 4 sides of the concrete pad, and only those sites located beyond the former railroad bed and tracks had no detections of metals above IDEM background. The presence of metals in the subsurface soil may be related to previous site activities. However, these metals are naturally occurring elements and, in many instances, sample concentrations only slightly exceed IDEM background values.

4.6.3 Conclusions

Based on the results of the investigation at EI Site 6, the following conclusions have been made:

- Metals exceeding IDEM background concentrations were identified in the 10 surface soil samples collected at the site. Seventeen metals exceeded IDEM background, with selenium, thallium, and zinc being the most frequently detected above IDEM background. These metals are naturally occurring, but may also be related to the storage of coal at the site.
- Metals exceeding IDEM background concentrations were detected in samples from 7 of the 11 shallow subsurface soil samples collected at the site. Four metals and cyanide exceeded

IDEM background, with sodium and selenium being the most frequently detected metals above IDEM background. These metals are naturally occurring, but may also be related to the storage of coal at the site.

4.6.4 Recommendations

Additional Phase II activities recommended for this site include additional sampling, background evaluation, and risk assessment as described below:

- Additional surface and subsurface soil sampling for PAH compounds should be conducted because PAH compounds are commonly associated with coal, and these compounds were not included in the Phase I analytical program for this site.
- A risk assessment should be performed for identified PAH compounds and metals (exceeding background concentrations) to evaluate potential risks associated with the site.

4.7 EI Site SM18: Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27

The Pesticide Mixing and Storage Areas at Building 27 were investigated as EI Site SM18. The building is a maintenance storage shed located along Otis Avenue. Figure 4.21 shows the general site layout.

4.7.1 Investigation Activities Performed

The investigation activities performed at Building 27 consisted of a records review and investigation sampling. These activities are discussed in the following subsections.

4.7.1.1 Records Review

Pesticides were formerly stored and mixed at the DIS Maintenance Storage Shed, Building 27. Pesticides and herbicides were stored in the basement of Building 27 during the 1970s (Weston, 1992). The basement is used as a boiler room/shed and has a concrete floor. Following the period of pesticide storage, Building 27 was flooded as the result of broken steam lines.

4.7.1.2 Investigation Sampling

The field investigation sampling at the DIS Maintenance Storage Shed, Building 27, consisted of the following:

- Collection and analysis of 2 surface-water samples and 3 sediment samples from the basement of Building 27

A summary of the Phase I sampling locations and rationale for sampling the DIS Maintenance Storage Shed, Building 27, is provided in Table 4.26. Figure 4.21 illustrates the approximate sampling locations within Building 27.

Samples collected from this location were analyzed for pesticides, herbicides, and total metals. In addition, surface-water samples were analyzed for dissolved metals. This suite of analytes was selected on the basis of historical information suggesting the site was used for storage of pesticides and herbicides (Weston, 1992). Metals are included in this suite because of the possibility that metal-containing pesticides were stored in this building. The individual compounds included in these analytical suites are presented in Section 3.3.

During sampling, it was observed that the level of water in the basement of the building is at approximately the same level where groundwater would be expected to be encountered. This similarity suggests that the groundwater and the standing water may be in hydraulic connection, and it is possible that the contamination in the building may be a source of groundwater contamination. In addition, field personnel observed that groundwater from the basement was pumped into the adjacent yard.

Surface-Water Sampling

Two samples of the standing water (SM018SW001 and SM018SW002) covering the basement floor of Building 27 were collected. One surface-water sample (SM018SW001) was collected in the northern room of Building 127 in front of shelves containing old, rusted cans of paint, pesticides and herbicides. The second surface-water sample (SM018SW002) was collected in the southern room of the building between areas of old, rusted 1-gallon cans of paint or pesticides and 50-pound bags of

unknown contents. Surface-water samples were analyzed for pesticides, herbicides, cyanide, and total and dissolved metals.

During the EI, HLA personnel observed water, which had flooded the basement of Building 27, being pumped onto the lawn near the southeast corner of the building. It appeared that the water was being pumped through an electric sump pump connected to a garden hose.

Sediment Sampling

Three sediment samples (SM018SE001, SM018SE002, SM018SE003) were collected from the thin layer of sediment present on the basement floor. Two sediment samples, SM018SE001 and SM018SE002, were collocated with the 2 surface-water samples (described above), and 1 sediment sample (SM018SE003) was collected from the floor along the northernmost wall near an old air-conditioner and under shelves containing plastic tubing. The sediment samples were analyzed for pesticides, herbicides, cyanide, and total metals.

4.7.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM18 are presented in this subsection. The analytical results for analytes that exceed background concentrations are discussed separately for surface-water and sediment.

4.7.2.1 Surface-Water Samples

Two surface-water samples were collected at EI Site SM18: SM018SW001 and SM018SW002. Because these samples were collected from the basement of Building 127, a loading analysis (mass/time) was not performed for this site. Table 4.27 lists all analytes detected above method reporting limits for both samples. The following summarizes the surface-water analytical results from EI Site SM18. Figure 4.22 shows the analytical results for the surface-water samples collected at this site.

Metals

Thirteen metals from the total metals analysis and 7 dissolved metals were detected in the surface-water samples at EI Site SM18. Dissolved metals detected included antimony, arsenic, copper, iron, manganese, sodium, and zinc. These metals are common in the surface-water and groundwater throughout the installation, and are not necessarily related to pesticide storage. In addition to the dissolved metals detected, the total metals analysis detected barium, cadmium, chromium, lead, nickel, and vanadium. Generally, the metals were found in both samples, but the concentrations tended to be higher in Sample SM018SW002 than in Sample SM018SW001.

Organics

Eleven pesticides and herbicides were detected above method reporting limits in surface samples at EI Site SM18, including alpha-chlordane; aldrin; dieldrin; endrin; gamma-chlordane; lindane; DDT; 2,2-bis(p-chlorophenyl)-1,1-dichloroethane(DDD); and DDE. The highest concentration detected was 10 mg/kg for both aldrin and DDD. Two of the herbicides detected above method reporting limits in surface-water samples at EI Site SM18 included 2,4-dichlorophenoxyaceticacid and 245T. The presence of these pesticides and herbicides probably results from the use of the basement for storage of pesticides and herbicides.

4.7.2.2 Sediment Samples

Table 4.28 presents a summary of the analytical results for metals and organic compounds detected in the respective sediment samples collected at this site. Figure 4.22 shows the analytical results of sediment samples collected at this site that exceed background concentrations.

Metals

Seventeen metals and cyanide were detected in at least 1 of the 3 sediment samples collected from EI Site SM18. In general, metals concentrations in Samples SM018SE001 and SM018SE003 are similar, but higher for Sample SM018SE002. Sample SM018SE002 had a high arsenic concentration of

910 mg/kg. Data for selenium were found to be unacceptable during independent data validation. The presence of metals and cyanide are likely to be the result of previous site activity.

Organic Compounds

Twelve organic compounds consisting of pesticides and herbicides were detected in 1 or more of the 3 sediment samples collected from EI Site SM18. The organic compound concentrations were similar among the 3 samples. The highest concentration detected was 92 mg/kg for dieldrin. The presence of pesticides and herbicides in high concentrations is likely related to previous site activities.

4.7.3 Conclusions

On the basis of the investigation sampling and the results of the investigation, the following conclusions have been made for EI Site SM18:

- Standing water in the basement of Building 27 may be in hydraulic connection with groundwater outside the building.
- Pumping of standing water from the basement of Building 27 into the adjacent yard may have transported pesticides and herbicides into the yard area.
- Thirteen metals including cadmium, chromium, and lead were detected in surface-water samples collected from the standing water in EI Site SM18. Sixteen metals and cyanide were detected in sediment samples collected from EI Site SM18. Arsenic had a concentration of 910 mg/kg for 1 sediment sample. The presence of some of these metals may be related to the use of the building for pesticide storage.
- Eleven pesticides and herbicides were detected in surface-water samples collected from the standing water in EI Site SM18. The highest concentration was 10 mg/kg for both aldrin and DDD.
- Twelve organic compounds consisting of pesticides and herbicides were detected in sediment samples collected from EI Site SM18. The highest concentration of these compounds was for dieldrin at 92 mg/kg.

4.7.4 Recommendations

Phase II activities recommended for this site include additional investigative sampling, risk assessment, and interim removal action, as discussed below:

- To assess the potential for pesticide-impacted soil near Building 27 because of past pesticide mixing practices, and because pesticide-impacted water from Building 27's basement was

observed being pumped onto the ground surface, 4 surface soil samples and 4 subsurface soil samples should be collected at a depth of approximately 5 feet bgs. These samples should be analyzed for metals, pesticides, and herbicides.

- The installation of 1 upgradient and 1 to 2 downgradient monitoring wells near Building 27 may be appropriate. Groundwater sampling and analysis should be performed to assess whether the building has had any impact on local groundwater quality.

- If pesticide and herbicide constituents are identified in soil or groundwater, a risk assessment should be performed at the site.

- The basement should be drained of water if the water is not in hydraulic connection with the groundwater. Any water pumped from the basement should be treated as a potentially hazardous substance and disposed of in accordance with applicable state and federal regulations. Water present in the basement of Building 27 should not be pumped onto the lawn due to the presence of contaminants in the water. If it appears that water in the basement is in hydraulic connection with groundwater, pumping of water is not recommended. The entrance to the basement should be secured and a warning sign should be posted in clear view so unauthorized personnel do not enter the basement and come in contact with contaminant-impacted water.

- The basement should be thoroughly cleaned. The sludge and sediment at the bottom of the basement should be removed and disposed of properly. All used pesticide containers should be removed and disposed of properly.

- The building should be considered for demolition, due to its poor current condition and contaminated basement. If the building is demolished, the rubble should be treated as potentially hazardous material, and disposed of in accordance with applicable state and federal regulations.

4.8 EI Site SM19: Pesticide Mixing and Storage Areas, Building 514

The Pesticide Mixing and Storage Areas at Building 514 and the area surrounding Building 514 were investigated as EI Site SM19. Figure 4.23 shows the general site layout.

4.8.1 Investigation Activities Performed

The investigative activities performed at Building 514 consisted of a records review and investigation sampling. These activities are discussed in the following subsections.

4.8.1.1 Records Review

Pesticides and herbicides were formerly stored and mixed at Building 514. Building 514 was used until the mid- to late-1980s for temporary storage of excess pesticides and herbicides when stocks exceeded the storage capabilities of Building 605. This over-supply situation normally occurred

when large shipments of Balan were received biannually for use at the golf course. Balan is a selective pre-emergence herbicide consisting of the compound n-Butyl-n-ethyl-2,6-dinitro-4 (trifluoro-methyl) benzene amine. Pesticide and herbicide application equipment were also stored in this building, which was deemed by AEHA in 1990 to be inadequate for storage of pesticides, herbicides, or application equipment.

4.8.1.2 Investigation Sampling

The field investigation sampling at the Pesticide Mixing and Storage Areas, Building 514, consisted of collecting and analyzing 12 surface soil samples and 1 duplicate surface soil sample. A summary of the Phase I sampling rationale and locations at the Pesticide Mixing and Storage Areas, Building 514, is provided in Table 4.29.

Samples collected from this location were analyzed for pesticides and herbicides. This suite of analytes was selected on the basis of historical information indicating the site was used for mixing pesticides and herbicides (Weston, 1992). The individual compounds included in these analytical suites are presented in Section 3.3.

Surface Soil Sampling

Twelve surface soil samples (SM019SS001 through SM019SS012) were collected from 0.0 to 0.5 foot bgs near Building 514 (Figure 4.23). Some sample locations were revised from those proposed in the TSP (HLA, 1993a), based on field observations, to target areas that may have been impacted by previous pesticide mixing activities (e.g., near doors to Building 514, near low-lying areas where surface-water could collect). Surface soil samples were analyzed for pesticides and herbicides.

4.8.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM19 are presented in this subsection. The analytical results for analytes that were detected are discussed separately for surface soil.

4.8.2.1 Surface Soil Samples

Table 4.30 presents a summary of the analytical results for organic compounds detected in the surface soil samples. Figure 4.23 shows the locations where the surface soil samples were collected at this site. Figure 4.24 shows the analytical results of surface soil samples collected at this site that had detections of organics.

Organic Compounds

Eight pesticides and 1 herbicide were detected in 9 of the 12 surface soil samples collected at this site. The number of pesticides and herbicides detected in surface soil samples ranged from 0 in samples collected from Sampling Locations SM019SS008, SM019SS009, and SM019SS011 to 7 compounds in samples collected from Sampling Location SM019SS006. Each alpha- and gamma-chlordane was detected in 6 surface soil sampling locations and in the duplicate surface soil samples, and were the compounds most frequently detected in surface soil samples (Table 4.30). The sample containing the largest number of pesticides (7) was collected from a location (SM019SS006) near the southern-facing door of Building 514. Each sample collected from Sampling Locations SM019SS003 and SM19SS007 contained four pesticides. The detections of dichloroprop in the sample from SM019SS004 (0.105 mg/kg), and alpha-chlordane (0.0762 mg/kg) and gamma-chlordane (0.0786 mg/kg) in the sample from SM019SS007 constitute the largest concentrations in the samples analyzed. Some of the pesticides detected may be the result of the basewide use of these compounds to control insects. However, on the basis of the number of compounds detected, surface soil collected at this site may have been impacted from pesticide mixing activities at the site.

4.8.3 Conclusions

On the basis of the investigation sampling and the results of the investigation at EI Site SM19, the following conclusions have been made:

- Eight pesticides and 1 herbicide were detected in surface soil at 9 sampling locations. The alpha- and gamma-chlordanes were the most frequently detected pesticides with the highest detections.

4.8.4 Recommendations

Sampling was conducted in the areas of the site considered the most likely to contain contamination, and low concentrations of pesticides were detected in surface soil. Based on these findings, the following recommendation is made:

- A baseline risk assessment is recommended to establish whether the detected pesticide and herbicide concentrations warrant remediation of soil in areas adjacent to Building 514.

4.9 EI Site SM20: Pesticide Mixing and Storage Areas, DIS Entomology, Building 605

Pesticides, herbicides, insecticides, and rodenticides were stored and mixed by the DIS Entomology Section in Building 605. The location of Building 605 is presented in Figure 4.25. Building 605 is located near Building 604. The Enhanced PA described Building 604 as also having been used for mixing and storage of pesticides; however, personal communication with site personnel indicates that the building has been used as the entomology office and a plumbing shop (Shafer, 1994). Reportedly, no pesticides were stored or mixed in Building 604.

Pesticides are mixed in the fenced area outside adjacent to Building 605. The outside mixing area is covered and has a curbed concrete floor with a catch basin for floor spills. Spills are pumped and/or bailed out of this catch basin to storage drums that are sent to the DRMO for storage and disposal. Rinsewater is used as a dilutant and disposed of through DRMO. Building 605 is located on top of a step embankment adjacent to a drainage northeast of Building 605. Surface runoff from EI Site SM20 may potentially drain into Hawthorne Lake located north of the site (Figure 3.1).

4.9.1 Investigation Activities Performed

The investigation activities performed at Building 605 consisted of investigation sampling. This investigation activity is discussed below.

4.9.1.1 Investigation Sampling

The field investigation sampling at the DIS Entomology, Building 605, consisted of the following activities:

- Collection and analysis of 12 surface soil samples and 1 duplicate surface-soil sample
- Collection and analysis of 4 subsurface soil samples from 4 soil borings and 1 duplicate subsurface-soil sample from 1 boring
- Collection and analysis of 2 surface-water samples and 1 duplicate surface-water sample
- Collection and analysis of 2 sediment samples

A summary of the Phase I sampling rationale and locations at DIS Entomology, Building 605, is provided in Table 4.31.

Samples collected from this location were analyzed for pesticides and herbicides. This suite of analytes was selected on the basis of historical information that suggested this site was used during the mixing and application of pesticides and herbicides (Weston, 1992). The individual compounds included in these analytical suites are presented in Section 3.3.

Surface Soil Sampling

Twelve surface soil samples (SM020SS001 through SM020SS012) were collected for chemical analysis in the vicinity of Building 605. Two of these surface soil samples (SM0202SS004 and SM020SS006) were collected in the runoff channel northeast of Building 605. One surface soil sample (SM020SS001) was collected in a brick-lined ditch southwest of Building 605. Some sample locations were revised from what was indicated in the TSP (HLA, 1993a) on the basis of field observations to certain areas that may have been impacted by previous pesticide mixing activities (e.g., near Building 605's doors, near low-lying areas where surface-water could collect). Surface soil samples were collected from 0.0 to 0.5 foot bgs. The surface soil samples were analyzed for pesticides and herbicides.

Soil Borings and Soil Sampling

Four soil borings (SM020SB001 through SM020SB004) were hand augered and sampled to a depth of approximately 5 feet bgs in the area northeast of Building 605. Soil samples collected from these borings were used to assess the vertical extent of soil potentially impacted by pesticides and herbicides at the site. One sample per boring was collected for chemical analysis from approximately 4 to 5 feet bgs.

Soil samples were analyzed for pesticides and herbicides. Boring logs are presented in Appendix H.

Surface-Water Sampling

Two surface-water samples (SM020SW001 through SM020SW002) were collected from the drainage northeast of Building 605 (Figure 4.25). Samples were collected approximately 125 feet upstream and 50 feet downstream of the location where runoff from Building 605 enters a drainage ditch. Sample locations were revised from what was proposed in the TSP (HLA, 1993a) because surface runoff from the site appeared to enter the drainage ditch, located northeast of Building 605, over a wider area than originally thought. Therefore, samples were collected further upstream and downstream than shown in the TSP. The surface-water samples were analyzed for pesticides and herbicides.

Flow of the water in the drainage ditch was measured to assess the potential total contaminant load and assess the source and movement of surface-water flow in the drainage. Stream flow measurement procedures are discussed in Appendix A of the TSP (HLA, 1993a). Water flow measurements and calculations are summarized in Appendix I.

Sediment Sampling

Two sediment samples (SM020SE001 and SM020SE002) were collected from the drainage area northeast of Building 605 where surface runoff from areas surrounding Building 605 could flow into the drainage ditch. These sediment samples were collocated with the two surface-water samples

approximately 125 feet upstream and approximately 50 feet downstream of the location where runoff from Building 605 enters the drainage ditch (Figure 4.25). Sample locations were revised from what was indicated in the TSP (HLA, 1993a) because surface runoff from the site appeared to enter the drainage ditch, located northeast of Building 605, over a wider area than originally thought. Therefore, the samples were collected further upstream and downstream than shown in the TSP. The sediment samples were analyzed for pesticides and herbicides.

4.9.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM20 are presented in this subsection. The analytical results for analytes that exceed the provided background concentrations or had detections of organics are discussed separately for surface soil, subsurface soil, surface water, and sediment.

4.9.2.1 Surface Soil Samples

Table 4.32 presents a summary of the analytical results for organic compounds detected in the surface soil samples. Figure 4.25 shows the locations where the surface soil samples were collected at this site. Figure 4.26 shows the analytical results of surface soil samples collected at this site that had organic compounds detected.

Organic Compounds

Organic compounds were detected in each of the 12 investigative and 1 duplicate surface soil samples collected at this site. Eleven organic compounds consisting of pesticides, herbicides, and PCBs were detected in surface soil collected from one or more sampling locations at this site. The number of compounds detected in surface soil samples ranged from 4 compounds in samples collected from Sampling Locations SM020SS009 through SM020SS012 to 9 compounds in samples collected from Sampling Locations SM020SS001 and SM020SS007. The pesticides, DDT and DDE, were detected in 13 surface soil samples and the compounds most frequently present in surface soil samples at concentrations as high as 6.8 mg/kg and 5.7 mg/kg, respectively. Dieldrin was detected in

12 surface soil samples, and DDD and PCB-1260 were detected in 10 surface soil samples (Table 4.32). Samples SM020SS001 and SM020SS007, which were collected from areas northwest and southwest of Building 605, respectively, contained the largest number of pesticides. Surface soil at this and other site locations including SM020SS002, SM020SS003, and SM020SS005 near Building 605, may have been impacted from pesticide mixing activities at this site. The surface soil sampling location, SM020SS010, furthest north of Buildings 604 and 605 had the highest DDT concentration of the surface soil sites sampled, indicating that pesticide mixing may have occurred in areas other than those used most recently.

The information HLA reviewed for this site did not indicate that PCBs, including PCB-1260, were used or stored at this site. However, PCB-1260 was detected in 10 surface soil samples collected at the site. The presence of PCB-1260 in the surface soil samples collected at this site may be related to the electrical repair shop formerly housed in Building 605. Although PCB concentrations in surface soil samples collected at this site were below the EPA (1990a) action level for soil in industrial areas (10 ppm), these samples exceeded the PCB action level for residential areas (1 ppm).

4.9.2.2 Subsurface Soil Samples

Table 4.33 presents a summary of the analytical results for organic compounds detected in the subsurface soil samples. Figure 4.25 shows the locations where the subsurface soil samples were collected at this site. Figure 4.27 shows the analytical results of subsurface soil samples collected at this site with detections of organic compounds.

Organic Compounds

Organic compounds were detected in subsurface soil samples collected from 2 of the 4 soil borings drilled at this site. Five pesticides and PCB-1260 were detected in samples from one or more sampling locations at this site. The number of organic compounds detected in subsurface soil samples collected from the 2 soil borings ranged from 1 in subsurface soil samples collected from Boring SM020SB002 (3-foot depth) to 6 in the sample collected from Boring SM020SB003 (3-foot

depth) located north of the pesticide mixing and storage building. The pesticide, DDT, was detected in 2 subsurface soil samples at concentrations of 0.00341 and 0.0272 mg/kg (Table 4.33).

4.9.2.3 Surface-Water Samples

Two surface-water samples were collected at EI Site SM20: SM020SW001 and SM020SW002. As stated in the TSP (HLA, 1993a), pesticide and herbicide analyses were performed on surface-water samples from this site.

Organic Compounds

The only organic compound detected was 2,4-D/2,4-dichlorophenoxyacetic acid. This detection occurred in the surface-water Sample SM020SW001 at a concentration of 0.43 μg/l, and this concentration was confirmed with the duplicate analysis; this sample was collected downstream of the site (Table 4.34). The herbicide 2,4-D/2,4-dichlorophenoxyaceticacid was also identified in the surface-soil samples collected at the site (Table 4.32). Figure 4.28 shows the analytical results of surface-water samples collected at this site that had detections of organic compounds.

4.9.2.4 Sediment Samples

Table 4.35 presents a summary of the analytical results for organic compounds detected in the respective samples collected upstream and downstream of this site. Figure 4.25 shows the approximate sampling location of the sediment samples. Figure 4.28 shows the analytical results of sediment samples collected at this site that had organic compounds detected.

Organic Compounds

Analytical results for analytes detected in sediment samples collected at EI Site SM20 indicate the presence of 3 analytes (dieldrin, gamma-chlordane, and DDT). All three analytes were detected in the downstream sample. Dieldrin was also identified in sediment collected upstream of the site. However, the analytical result for dieldrin in the upstream sediment sample (SM022SE002) was rejected during independent data validation. It is, therefore, uncertain whether the dieldrin

identified originates at the site or is the result of basewide pesticide use. The other pesticides appear to be site-related.

4.9.3 Conclusions

On the basis of the investigation sampling and the results of the investigation at EI Site SM20, the following conclusions have been made:

- Surface soil concentrations of detected organics were reported for 11 organic compounds, including PCB-1260 and 10 pesticides and herbicides. PCB concentrations in surface soil samples were below the EPA (1990a) action level (10 ppm) for soil in industrial areas.
- Organics were detected in surface soil samples located throughout the site, indicating that the extent has not been characterized.
- Subsurface soil concentrations of detected organics were reported for 6 pesticides in samples from 2 of 4 borings, drilled with most of the detected pesticides confined to subsurface soil collected from 1 boring located north of the pesticide mixing and storage area.
- Surface-water concentrations of organics were detected for 1 herbicide (2,4-D) in 1 surface-water sample from the downstream sampling location.
- Three pesticides were detected in sediment samples collected from the downstream sampling location.

4.9.4 Recommendations

Phase II activities recommended for this site include additional sampling, risk assessment, and evaluation of the need for site remediation, as described below:

- Install monitoring wells; sample and analyze groundwater samples to evaluate the possible presence of constituents in groundwater.
- Collect additional surface and subsurface soil samples to assess the extent of pesticide and herbicide contamination.
- Conduct a risk assessment as part of the Phase II EI investigation. The purpose of the risk assessment is to evaluate the risk associated with pesticides and herbicides identified at the site.

4.10 EI Site SM21: Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, Building 674

The small wooden golf course shed adjacent to Building 674 and the area near Building 674 were investigated as EI Site SM21. Pesticides were stored in the small wooden shed adjacent to Building 674 at the golf course. The shed lacked a concrete floor with continuous cubing for spill containment. In addition, pesticides were mixed outside of Building 674 (Weston, 1992). Figure 4.29 shows the general site layout.

4.10.1 Investigation Activities Performed

The investigation activities performed at the pesticide mixing and storage areas near Building 674 included investigation sampling. This activity is discussed below.

4.10.1.1 Investigation Sampling

The field investigation sampling at the golf course shed adjacent to Building 674 consisted of collecting and analyzing 12 surface soil, 1 duplicate surface soil, and 2 sediment samples. A summary of Phase I sampling and rationale at Building 674 is provided in Table 4.36.

Samples collected from this location were analyzed for pesticides and herbicides. This suite of analytes was selected on the basis of historical information that suggested this site was used during the mixing and application of pesticides and herbicides (Weston, 1992). The individual compounds included in these analytical suites are presented in Section 3.3.

Surface Soil Sampling

A total of 12 surface soil samples (SM021SS001 through SM021SS012) were collected from 0.0 to 0.5 foot bgs in an area around Building 674. Eight of the 12 samples (SM021SS001 through SM021SS008), as well as the duplicate sample (SM021SS003-Dup), were collected in or next to the ground-covered mixing area on the north side of Building 674 and near the storage shed at the west end of Building 674. Two of the 12 samples (SM021SS011 and SM021SS012) were collected in the rill leading away from the wash rack on the southwest side of Building 674, and 2 of the 12 samples

(SM021SS009 and SM021SS010) were collected to assess background conditions at the site. Approximate surface soil sampling locations are shown in Figure 4.29. Some sample locations were revised from what was indicated in the TSP (HLA, 1993a) to target areas that may have been impacted by previous pesticide mixing activities and/or spills. Surface soil samples were analyzed for pesticides and herbicides.

Sediment Sampling

Two sediment samples (SM021SE001 and SM021SE002) were collected from the roadside ditch along the north side of Shafter Road, south of Building 674 because surface runoff form the area surrounding Building 674 flows into the ditch. Sediment samples were collected approximately 35 feet upstream and 50 feet downstream of the locations where runoff from Building 674 enters the ditch, as shown in Figure 4.29. The sediment samples were analyzed for pesticides and herbicides.

4.10.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM21 are presented in this subsection. The analytical results for detected organic analytes are discussed separately for surface soil and sediment.

4.10.2.1 Surface Soil Samples

Table 4.37 presents a summary of the analytical results for organic compounds detected in the surface soil samples. Figure 4.29 shows the locations where the surface soil samples are collected at this site. Figure 4.30 shows the analytical results of surface soil samples collected at this site that exceed background concentrations.

Organic Compounds

Organic compounds were detected in 11 of the 12 investigative surface soil samples collected at this site, as well as in the duplicate sample. Nine organic compounds including pesticides and herbicides were detected at 1 or more sampling locations at the site. The number of organic compounds detected in the surface soil samples ranged from 0 in Sample SM021SS010 to 5 compounds in the

surface soil Samples SM021SS003-Dup and SM021SS007. (The fifth compound identified in SM021SS09 was found unacceptable during data validation.) The alpha- and gamma-chlordanes each were detected in 12 surface soil sampling locations and were the compounds most frequently detected in surface soil samples (Table 4.37). Heptachlor epoxide was identified in 6 surface soil samples. The locations of surface soil samples containing pesticides are distributed across the site including samples collected south and north of the site. Only surface soil Sample SM021SS010 contained no pesticide or herbicide detections. With the possible exception of DDT, DDD, and DDE, the pesticides and herbicides appear to be related to mixing and storage at the site. The pesticides DDT, DDD, and DDE may be related to basewide pesticide use.

4.10.2.2 Sediment Samples

Table 4.38 presents a summary of the analytical results for organic compounds detected in the respective sediment samples collected upstream and downstream of the site. Figure 4.29 shows the locations where the sediment samples were collected at this site. Figure 4.31 shows the analytical results of sediment samples collected at this site.

Analytical results for analytes detected in sediment samples collected at EI Site SM21 indicate the presence of 5 organic pesticides (alpha-chlordane; gamma-chlordane; heptachlor epoxide; DDE; and DDT). The downstream sample had detections for 3 pesticides (alpha-chlordane [0.55 mg/kg], gamma-chlordane [0.55 mg/kg], and heptachlor epoxide [0.0178 mg/kg]). These pesticides were the most frequently detected pesticides in surface soil samples at this site (Table 4.37), and probably result from runoff from the mixing area. The upstream sample had detections for 2 organic analytes (DDE and DDT). The concentrations of DDE and DDT are near their respective reporting limits and may be due to the former basewide use of these pesticides.

4.10.3 Conclusions

On the basis of the investigation sampling and the results of the investigation at EI Site SM21, the following conclusions have been made:

- Of 12 surface soil samples collected, 11 contained detectable concentrations of 1 or more pesticides or herbicides. With the possible exception of DDT, DDD, and DDE, the pesticides appear to be related to onsite mixing and storage activities.
- Sediment concentrations of organics indicate the presence of 5 pesticides at both the upstream and downstream sediment sampling locations. Three pesticides (alpha-chlordane, gamma-chlordane, heptachlor epoxide) were detected in the downstream sample but not in the upstream sample. These pesticides were also identified in onsite surface soil samples. Two pesticides (DDE and DDT) were detected in the upstream sample but not in the downstream sample. The pesticides may result from the former basewide use of DDT.

4.10.4 Recommendations

Phase II activities recommended for this site include additional sampling, risk assessment, and evaluation of the need for site remediation as described below:

- Collect additional surface and soil samples to assess extent of pesticides in these media.
- Drill a limited number of soil borings and install and sample up to 4 monitoring wells to assess pesticides in subsurface soil and groundwater.
- Conduct a risk assessment for chemicals of concern associated with the site.

4.11 EI Site SM22: Firing Range, Foreman Rifle Range, Near Buildings 811 and 812

The Foreman Rifle Range is an outdoor area adjacent to Buildings 811 and 812. Figure 4.32 shows the general site layout. Until recently, approximately 5000 people used the range annually for qualification firing of handguns, rifles, and shotguns. Rounds are fired into a hillside adjacent to a tributary of Lawrence Creek.

4.11.1 Investigation Activities Performed

The investigation activities performed at the Foreman Rifle Range included investigation sampling. These activities are discussed in the following subsections and are summarized in Table 4.39.

4.11.1.1 Investigation Sampling

The field investigation sampling at the Foreman Rifle Range, near Buildings 811 and 812, consisted of the following activities:

- Collection and analysis of 22 surface soil samples at 11 locations
- Collection and analysis of 10 subsurface soil samples from 5 soil borings, and 1 duplicate subsurface sample
- Collection and analysis of 2 surface-water samples
- Collection and analysis of 2 sediment samples

A summary of Phase I sampling rationale and locations at the Foreman Rifle Range is provided in Table 4.39. Foreman Rifle Range sampling locations are illustrated in Figure 4.32.

Samples collected from this location were analyzed for total metals. In addition, the surface-water samples were analyzed for dissolved metals. Metals were selected based on current and historical information indicating this site was used as a small arms firing range (Weston, 1992). The individual metals included in the analytical suite are presented in Section 3.3.

Surface Soil Sampling

Twenty-two surface soil samples were collected from 11 locations on the hillside impacted from the firing of ammunition. Sampling locations were revised from proposed locations shown in the TSP (HLA, 1993a) on the basis of field observations of usage patterns at the firing range. Soil samples were collected from 0.0 to 0.5 foot bgs. Surface soil samples (SM022SS001 through SM022SS011) were analyzed for cyanide and total metals. At each sampling location, a duplicate soil sample was collected. One sample was submitted to the laboratory for analysis of cyanide and total metals, and the duplicate sample was analyzed by HLA field personnel for bullet fragment content. Field procedures for evaluating the bullet fragment content of soil samples and the results are presented in Appendix J.

Soil Boring and Subsurface Soil Sampling

Subsurface soil samples were collected at 5 representative locations (Borings SM022SB001 through SM022SB005) across the face of the firing range hillside bullet impact area. These sampling locations were collocated with 5 of the surface soil sampling locations. Soil samples were collected

at each soil boring from approximately 0.5 to 3.0 feet bgs using a hand auger. The 0.5- to 2.5-foot fraction of each soil sample was analyzed by HLA personnel to evaluate bullet and bullet fragment content using the same methods described for surface soil sampling. The 2.5- to 3.0-foot fraction of each soil sample was submitted to the laboratory for total metals and cyanide analysis to assess the mobility of these analytes in the soil. In lieu of using a drive sampler with a split-spoon sampler to collect subsurface soil samples, as was discussed in Appendix A of the TSP (HLA, 1993a), a stainless-steel hand auger was used to collect the soil samples due to the very poor sample recovery rate when using the drive sampler. A duplicate subsurface soil sample was collected at SM022SB002 and identified as SM0225B002-Dup. Boring logs are presented in Appendix H.

Surface-Water Sampling

Two surface-water samples (SM022SW001 and SM022SW002) from Schoen Creek were collected and analyzed for cyanide and total and dissolved metals. The surface-water samples were collected at a location approximately 25 feet upstream (SM022SW002) and 25 feet downstream (SM022SW001) of the firing range.

Stream flow measurements of Schoen Creek were made during sampling by following procedures discussed in Appendix A of the TSP (HLA, 1993a). The stream flow measurements were used to calculate metal load and assess whether the firing range is a source of metal loading. Results of metal loading calculations are discussed in Section 3.0. Stream flow measurements and calculations are presented in Appendix I.

Sediment Sampling

Two sediment samples (SM022SE001 and SM022SE002) were collected from Schoen Creek. As indicated above, ammunition is fired at a hillside adjacent to Schoen Creek. To evaluate leaching of metals from the hillside into the stream and the transport of small metal particles as sediment, sediment samples were collected from the creek and analyzed. Sediment samples were collected at the same locations the surface-water samples at this site were collected (Figure 4.32). Before

collecting sediment samples, the flow and sedimentation pattern of the stream were visually observed to select representative sampling locations. The sediment sampling locations were collocated with the two surface-water sample locations.

4.11.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM22 are presented in this subsection. The analytical results for analytes that exceed background concentrations are discussed separately for surface soil, subsurface soil, surface water, and sediment. A summary of the bullet fragment analysis is also presented in this section.

4.11.2.1 Surface Soil Samples

Table 4.40 presents a summary of the analytical results for analytes detected in the surface soil samples at concentrations greater than IDEM background. Figure 4.32 shows the locations where the surface soil samples were collected at this site. Figure 4.33 shows the analytical results of surface soil samples collected at this site that exceed IDEM background concentrations.

Metals

Metals concentrations that exceeded IDEM background concentrations were detected in each of the 11 surface soil samples collected and submitted for laboratory analysis. Eight metals and cyanide exceeded IDEM background concentrations at 1 or more sampling locations at this site. The number of metals in the 11 surface soil samples that exceeded IDEM background concentrations ranged from 3 metals in the sample collected from Sampling Location SM022SS005 to seven metals in the sample collected from Sampling Location SM022SS008. Lead and copper were detected in all 11 surface soil samples and were the metals most frequently detected in surface soil samples at concentrations that exceeded IDEM background concentrations. Lead concentrations as high as 49,000 mg/kg and copper concentrations as high as 3090 mg/kg were detected in surface soil samples collected from this site. The lead concentrations of this site exceed the EPA (1994c) recommended screening level for residential soil (400 ppm). Antimony was detected in 10 surface soil samples at concentrations

ranging from 11.7 mg/kg to 583 mg/kg. Arsenic was detected in 9 surface soil samples at concentrations above background that ranged from 7.6 mg/kg to 32 mg/kg.

Metals are naturally occurring elements and their presence at the site is not necessarily related to the use of the site as a firing range. However, several metals (including antimony, copper, lead, and zinc) have been identified in the rounds used by the military at small arms ranges (Heath and others, 1991). The high concentrations of these metals in surface soil reflects use of the site as a firing range.

Other metals identified as exceeding IDEM background (arsenic, beryllium, silver, and thallium) are not related to the use of the site as a firing range and probably occur naturally at the site. Cyanide was detected at a low concentration of 0.381 mg/kg. This value may be a laboratory artifact because cyanide was only detected in 1 of the 11 surface soil samples collected, and because cyanide was detected at a concentration that was close to the 0.25 mg/kg reporting limit for this analysis.

The extent of elevated metals concentrations in the surface soil samples has not been completely assessed. Surface soil near the boundary of the site (e.g., SM022SS001 and SM022SS010) contained elevated metals concentrations indicating the extent of surface soil containing elevated metals concentrations is greater than initially estimated.

4.11.2.2 Subsurface Soil Samples

Table 4.41 presents a summary of the analytical results for analytes detected in subsurface soil samples at concentrations greater than background. Figure 4.32 illustrates the locations where the subsurface soil samples were collected at this site. Figure 4.34 shows the analytical results of subsurface soil samples collected at this site that exceed IDEM background concentrations.

Metals

Metals with concentrations that exceeded IDEM background concentrations were detected in subsurface samples collected from each of the 5 soil borings drilled at this site and in the duplicate sample. Seven metals exceeded IDEM background concentrations at 1 or more sampling locations at this site. The number of metals that exceeded IDEM background concentrations in subsurface soil samples collected from the 5 soil borings ranged from 1 in the sample collected from Boring SM022SB004 (2.5-foot depth) to 3 metals in the samples collected from Boring SM022SB005 (2.4-foot depth). Lead and copper were detected in 6 and 3 subsurface soil samples, respectively, at concentrations that exceeded IDEM background and were the metals most frequently present in subsurface soil samples. The maximum concentrations of lead and copper in subsurface soil samples collected at this site were 3920 mg/kg and 64.10 mg/kg, respectively. The metals concentrations in the subsurface soil samples are much less than the respective metals concentrations in the surface soil samples. This observation is consistent with the use of the site as a firing range with bullets and bullet fragments residing primarily in the surface soil.

4.11.2.3 Bullet Fragment Analysis

Surface and subsurface soil samples collected at this site were analyzed for bullet and bullet fragment content. The analysis procedures are described in Appendix J and results are included in Table 4.42. Generally the percent of bullets and bullet fragments was greater in the surface soil samples than in the subsurface soil samples. The percent by weight of bullets and bullet fragments in surface soil samples ranged from 1.31 percent in surface soil Sample SM022SS004 to 18.86 percent in surface soil Sample SM022SS008. The percent by weight of bullets and bullet fragments in subsurface soil samples collected from this site ranged from 0.0 percent in several of the subsurface soil samples to 10.26 percent in Sample SM022SB001 (1.0 to 1.5-foot depth [see Appendix J]). The higher percentage of bullets and bullet fragments in the surface soil samples than in the subsurface soil samples is consistent with the use of this site as a firing range.

4.11.2.4 Surface-Water Samples

A loading analysis (mass/time) was performed for this site to compare the mass of analyte flowing in the stream immediately above and below the site. The upstream flow calculation was based on a simple velocity measurement and was not considered sufficiently accurate for the loading analysis. Therefore, the upstream flow rate for SM022SW002 was assumed to equal the calculated downstream flow rate at SM022SW001. This is a reasonable assumption, because the 2 samples were collected approximately 150 feet apart. Table 4.43 lists analytes detected above method reporting limits for the upstream and downstream samples (concentration and load for each sample are presented). The following summarizes the analytical results from EI Site SM22. Figure 4.35 shows the analytical results of surface-water samples collected at this site.

Metals

Seven metals from the total metals analysis and 4 dissolved metals (antimony results were qualified unacceptable during independent data validation) were detected in the surface-water samples collected at EI Site SM22. Of the metals detected in the total metals analysis, lead and sodium were observed to increase downstream of the site. Lead was not detected in the upstream sample but was detected in the downstream sample at a concentration of 3 mg/kg. This concentration is below the acute and chronic ambient water criteria for lead in surface water (Table 4.43). The increase in total lead is likely due to use of the site as a firing range. Dissolved metals detected include barium, iron, manganese, and sodium. Of the dissolved metals detected, barium, iron, manganese, and sodium were observed to increase downstream of the site. Except for iron, the increase in concentration and mass were minor.

4.11.2.5 Sediment Samples

Table 4.44 presents a summary of the analytical results for analytes detected in the respective sediment samples collected upstream and downstream of this site. Figure 4.32 illustrates the locations where the sediment samples were collected at this site. Analytical results for analytes detected in sediment samples collected at EI Site SM22 are discussed below. The metals were

detected at higher concentrations in the downstream sample (SM022SE001) than in the upstream sample (SM022SE002). Iron and manganese had the highest concentrations of the metals detected in either the respective upstream or downstream samples. The upstream concentrations for iron and manganese were 10,900 and 363 mg/kg, respectively, and the downstream concentrations were 16,800 and 962 mg/kg, respectively. Lead and copper concentrations increased from 24.9 and 22.9 mg/kg, respectively, for the upstream sample to 361 and 80.2 mg/kg for the downstream sample. The increase in metals concentrations in the downstream sediment sample in comparison to the upstream sediment sample is probably the result of runoff and soil from this site entering the stream. Figure 4.35 shows the analytical results of sediment samples collected at this site.

4.11.3 Conclusions

On the basis of the investigation sampling and the results of the investigation at EI Site SM22, the following conclusions have been made:

- Surface soil concentrations of metals exceeded IDEM background concentrations in all 11 samples. The most frequently detected metals were lead and copper. These metals also had the highest concentrations above IDEM background, with maximum concentrations of 49,000 mg/kg and 3090 mg/kg, respectively. Observed lead concentrations exceed the EPA (1994c) recommended screening level for residential soil (400 ppm). The elevated concentrations of metals, including antimony, copper, lead, and zinc, in the surface soil samples is consistent with use of the site as a firing range.
- Subsurface soil concentrations of metals exceeded IDEM background concentrations in samples collected from all 5 borings. Lead and copper were the most frequently detected metals, but the maximum concentrations (3920 mg/kg and 64.10 mg/kg, respectively) were lower than lead and copper concentrations in surface soil.
- Surface-water concentrations for dissolved lead increased downstream of the firing range site. The observed concentration is below acute and chronic AWQC for lead in surface water.
- Sediment concentrations of metals indicated elevated levels of 12 metals in both upstream and downstream samples. Downstream concentrations of metals such as iron, manganese, lead, and copper are higher than upstream concentration and may be the result of runoff from the adjacent bullet impact area of the firing range.

4.11.4 Recommendations

Phase II activities recommended for this site include additional sampling, risk assessment, and evaluation of possible remediation processes as described below:

- Conduct field screening to delineate extent of elevated lead concentrations in surface soil.
- Install monitoring wells and assess the affect of evaluated metals on local groundwater quality.
- Conduct a risk assessment and ecological assessment to evaluate risks associated with chemicals of concern at this site.
- Conduct an accelerated FS and implement interim remedial measures for the firing range backstop to remove the primary source of lead at the site.

4.12 EI Site SM23: Firing Range, State Police Pistol Range, Near Building 815

The State Police Pistol Range is an outdoor area located in the vicinity of Building 815. Figure 4.36 shows the general site layout. The range is used by the Indiana State Police and a sheriff's department for firing handguns, rifles, and shotguns. Rounds are fired into a hillside adjacent to Lawrence Creek.

4.12.1 Investigation Activities Performed

The investigation activities performed at the State Police Pistol Range included investigation sampling. This activity is discussed below.

4.12.1.1 Investigation Sampling

The field investigation sampling at the State Police Pistol Range, near Building 815, consisted of the following activities:

- Collection and analysis of 20 surface soil samples at 10 locations and 1 duplicate sample from 1 location
- Collection and analysis of 10 subsurface soil samples from 5 soil borings and 1 duplicate sample from 1 boring
- Collection and analysis of 2 surface-water samples and 1 duplicate surface-water sample
- Collection and analysis of 2 sediment samples

A summary of Phase I sampling rational and locations at the State Police Pistol Range is provided in Table 4.45. State Police Pistol Range sampling locations are illustrated in Figure 4.36.

Samples collected from this location were analyzed for cyanide and total metals. In addition, surface-water samples were analyzed for dissolved metals. Metals were selected because this site is currently being used as a small arms firing range. The individual metals included in the analytical suite are presented in Section 3.3.

Surface Soil Sampling

Twenty surface soil samples were collected from 10 locations on the hillside impacted from the firing of ammunition. Sample locations were revised from proposed locations shown in the TSP (HLA, 1993a) based on field observations of usage patterns at the firing range. Surface soil samples (SM023SS001 through SM023SS010) were collected from 0.0 to 0.5 foot bgs. Surface soil samples were analyzed for cyanide and total metals. At each sampling location, 2 duplicate soil samples were collected. One sample was submitted to the laboratory for cyanide and total metals analysis and the other sample was analyzed by HLA field personnel for bullet and bullet fragment content. Field procedures for evaluating the bullet fragment content of soil samples and the results are presented in Appendix J.

Soil Boring and Subsurface Soil Sampling

Subsurface soil samples were collected at 5 representative locations (soil Borings SM023SB001 through SM023SB005) across the face of the firing range hillside bullet impact area. These soil borings were collocated with 5 of the surface soil sampling locations. Soil samples were collected from each soil boring from approximately 0.5 to 3.0 feet bgs using a hand auger. The 0.5- to 2.5-foot fraction of each soil sample was analyzed by HLA personnel to evaluate bullet and bullet fragment content using the same methods described for the surface soil sampling. The 2.5- to 3.0-foot fraction of each soil sample was submitted to the laboratory for cyanide and total metals analysis to assess the mobility of analytes in the soil. In lieu of using a hand driven slide hammer with a split-spoon sampler to collect subsurface soil samples, as discussed in Appendix A of the TSP (HLA, 1993a), a stainless-steel hand auger was used to collect the soil samples due to the very poor sample recovery rate when using the split-spoon sampler. Boring logs are presented in Appendix H.

Surface-Water Sampling

Two surface-water samples (SM023SW001 and SM023SW002) from Lawrence Creek were collected and analyzed for cyanide and total and dissolved metals. The surface-water samples were collected at locations approximately 50 feet upstream (SM023SW001) and 25 feet downstream (SM023SW002) of the firing range.

Stream flow measurements of Lawrence Creek were made during sampling by following procedures described in Appendix A of the TSP (HLA, 1993a). The stream flow measurements were used to calculate the possible metals load and to help assess whether the firing range is a source of metals loading. Stream flow measurements and calculations are presented in Appendix I.

Sediment Sampling

Two sediment samples (SM023SE001 and SM023SE002) were collected from Lawrence Creek. As indicated above, ammunition is fired into a hillside adjacent to Lawrence Creek. To evaluate possible leaching of metals from the hillside into the stream and the transport of small metal particles as sediment, sediment samples were collected from the creek and analyzed. Sediment samples were collected at the same locations the surface-water samples at the site were collected (Figure 4.36). Before collecting the sediment samples, the flow and sedimentation pattern of the stream were visually observed to select representative sampling locations. The sediment sampling locations were near surface-water sample locations.

4.12.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM23 are presented in this subsection. The analytical results for analytes that exceed the provided background concentrations or have organic detections are discussed separately for surface soil, subsurface soil, surface water, and sediment. A summary of the bullet fragment analysis is also presented in this section.

4.12.2.1 Surface Soil Samples

Table 4.46 presents a summary of the analytical results for metals detected at concentrations greater than background concentrations in the surface soil samples. Figure 4.36 shows the locations where the surface soil samples were collected at this site. Figure 4.37 shows the analytical results of surface soil samples collected at this site that exceed IDEM background concentrations.

Metals

Metals concentrations that exceeded IDEM background concentrations were detected in each of the 10 surface soil samples collected at this site and submitted to the laboratory for analysis. Nine metals exceeded IDEM background concentrations at 1 or more sampling locations at this site. The number of metals that exceeded IDEM background concentrations in the 10 surface soil samples and 1 duplicate sample ranged from 4 metals in Samples SM023SS002 and SM023SS006 to 7 metals in Samples SM023SS001 and SM023SS009. Lead, copper, and thallium were detected in each of the surface soil samples and were the metals most frequently detected. Antimony and arsenic had 10 and 9 detections, respectively, above IDEM background. Lead concentrations as high as 99,000 mg/kg were detected in surface soil samples (SM023SS001) collected from this site (see Table 4.46). Ten of the lead concentrations reported at this site exceeded the EPA (1994c) recommended screening level for residential soil (400 ppm). Metals are naturally occurring elements, and their presence at the site is not necessarily related to the use of the site as a firing range. However, several metals (including antimony, copper, lead, and zinc) have been identified in the rounds used by the military at small arms ranges (Heath and others, 1991). The high concentrations of these metals in surface soil reflects use of the site as a firing range. Other metals identified as exceeding IDEM background (arsenic, cobalt, nickel, silver, sodium, and thallium) are not related to the use of the site as a firing range and probably occur naturally at the site. It is likely the extent of surface soil containing elevated metals concentrations has not been defined.

4.12.2.2 Subsurface Soil Samples

Table 4.47 presents a summary of the analytical results for analytes detected in the subsurface soil samples at concentrations greater than IDEM background. Figure 4.36 shows the locations where the surface soil samples were collected at this site. Figure 4.38 shows the analytical results of subsurface soil samples collected at this site that exceed IDEM background concentrations.

Metals

Metals concentrations that exceeded IDEM background concentrations were detected in subsurface samples collected from each of the 5 soil borings hand augered at this site. Six metals exceeded IDEM background concentrations at 1 or more sampling locations at this site. The number of metals that exceeded IDEM background concentrations in subsurface soil samples collected from the 5 soil borings ranged from 1 in the sample collected from Sampling Location SM023SB001 (2.5-foot depth) to 4 in the sample collected from Sampling Location SM023SB003 (2.5-foot depth). Lead and thallium were detected in 4 subsurface soil samples and were the metals most frequently detected in subsurface soil samples at concentrations that exceeded IDEM background levels (Table 4.47). Lead was detected at concentrations as high as 230 mg/kg. However, the metals concentrations in the subsurface soil samples that exceed IDEM background are much less than the respective metals concentrations in the surface soil. This observation is consistent with the use of the site as a firing range with bullets and bullet fragments having greater impact in the surface soil.

4.12.2.3 Bullet Fragment Analysis

Surface and subsurface soil samples collected at this site were analyzed for bullet and bullet fragment content. The analysis procedures are described in Appendix J and results are included in Table 4.48. Generally the percent of bullets and bullet fragments was greater in the surface soil samples than in the subsurface soil samples. The percent by weight of bullets and bullet fragments in surface soil samples ranged from 0.17 percent in surface soil Sample SM023SS010 to 50.06 percent in surface soil Sample SM023SS004. The percent by weight of bullets and bullet fragments in subsurface soil samples collected from this site ranged from 0.0 percent in several of the

subsurface soil samples to 17.08 percent in Sample SM023SB004 (0.5 to 1.0 foot depth [see Appendix J]). The higher percentage of bullets and bullet fragments in the surface soil samples than in the subsurface soil samples is consistent with the use of this site as a pistol range.

4.12.2.4 Surface-Water Samples

Two surface-water samples were collected at EI Site SM23: SM023SW001 and SM023SW002. A loading analysis (mass/time) was performed for this site to compare the mass of analyte flowing in the stream immediately above and below the site. Table 4.49 lists analytes detected above method reporting limits for the upstream and downstream samples (concentration and load for each sample is presented). The following section summarizes the analytical results from EI Site SM23. Figure 4.39 shows the analytical results for the metals in the surface-water samples collected at this site that exceed background concentrations.

Metals

Five metals in the total metals analysis and 6 metals in the dissolved metals analysis (antimony results were rejected during the independent data validation) were detected in the surface-water samples at EI Site SM23. Metals detected in the total metals analysis in surface water include barium, iron, lead, manganese, and sodium. Dissolved metals detected in surface water include barium, copper, iron, lead, manganese, and sodium. Detected analytes (total and dissolved) increased downstream of the site. Total and dissolved lead concentrations at the downstream sampling location exceed chronic AWQC (Table 4.49). Because both the stream flow rate and metal concentrations increased between the upstream sampling location and the downstream sampling location, the metal load was greater downstream of the site than upstream of the site. Increases in metals concentrations and load, especially lead and copper, are probably related to use of the site as a firing range.

4.12.2.5 Sediment Samples

Table 4.50 presents a summary of the analytical results for analytes detected in the respective sediment samples collected upstream and downstream of the site. Figure 4.36 shows the locations where the sediment samples were collected at this site. Figure 4.39 shows the analytical results of sediment samples collected at this site.

Metals

Analytical results for analytes detected in sediment samples collected at EI Site SM23 indicate the presence of 12 metals. All of the metals were detected at higher concentrations in the downstream sample than in the upstream sample. The increase in metals concentrations in the downstream sediment sample, when compared to the upstream sediment sample, is likely the result of runoff and soil from the adjacent hillside impacted by bullets entering into the stream.

4.12.3 Conclusions

On the basis of the investigation sampling and the results of the investigation at EI Site SM23, the following conclusions have been made:

- Surface soil metals concentrations exceeded IDEM background concentrations in all 10 sampling locations. The most frequently detected metals were lead, copper, and thallium, and the metal with the highest concentrations above IDEM background was lead. Observed lead concentrations greatly exceed the EPA (1994c) recommended screening level for residential soil (400 ppm). Metals concentrations in the surface soil are consistent with site firing range activities.

- Subsurface soil concentrations of metals exceeded IDEM background concentrations in samples collected from the 5 sampling locations. Lead and thallium were the most frequently detected metals, but were detected at lower concentrations than in surface soil.

- Surface-water concentrations of 9 total and 10 dissolved metals were reported. Analyte concentrations were generally greater in the downstream sample then in the upstream sample. Total and dissolved lead concentrations at the downstream station exceed EPA (1986a) chronic AWQC.

- Sediment concentrations of metals indicated detections of 16 metals in both upstream and downstream samples. Downstream metals concentrations were higher than upstream concentrations.

4.12.4 Recommendations

Phase II activities recommended for this site include additional sampling, risk assessment, and evaluation of possible remediation processes as described below:

- Conduct field screening to delineate the extent of elevated lead concentrations in surface soil.
- Install monitoring wells and assess the effects of elevated metals on local groundwater quality.
- Conduct a baseline risk assessment and ecological assessment to evaluate exposure pathways and associated risks in more detail.
- Conduct an accelerated FS and implement interim remedial measures for firing range backstop to remove primary source of lead at the site.

4.13 EI Site SM24: Firing Range, Skeet/Rifle Range, Near Buildings 819 Through 822

The Skeet/Rifle Range is an outdoor area in the vicinity of Buildings 819 through 822. Figure 4.40 shows the general site layout. The range is used by the Rod and Gun Club for firing shotguns. Rifle and pistol ranges have been located in the area in the past.

4.13.1 Investigation Activities Performed

The investigation activities performed at the Skeet/Rifle Range included investigation sampling. These activities are discussed in the following subsections.

4.13.1.1 Investigation Sampling

The field investigation at the Skeet/Rifle Range consisted of the following activities:

- Collection and analysis of 34 surface soil samples collected from 17 locations and 2 duplicate samples collected from 2 locations
- Analysis of 12 subsurface soil samples collected from 6 soil borings and 1 duplicate sample collected from 1 location

A summary of Phase I sampling rationale and locations at the Skeet/Rifle Range is provided in Table 4.51. Skeet/Rifle Range sampling locations are illustrated in Figure 4.40.

Samples collected from this location were analyzed for total metals. Metals were selected on the basis of current and historical information that indicated this site was used as a firing range for small arms (Weston, 1992). The individual compounds included in these analytical suites are presented in Section 3.1.

Surface Soil Sampling

Thirty-four surface soil samples were collected from 17 locations north of the range in areas suspected of receiving spent shot from the firing of shotguns or bullets from the firing of rifles. Soil sampling locations were selected after completion of a field survey. The field survey was conducted by establishing transect lines perpendicular to the firing line. The ground surface was visually examined in the field approximately every 50 feet along the transect lines for the presence of spent shot and bullets. Field survey points were examined at 50-foot intervals in a direction away from the firing line until spent shot/bullets were not observed at three consecutive survey points along the transect line. Observations from this field survey were recorded in a field logbook. The areas identified by the survey as having received a large (easily visible) quantity of spent shot or bullets along these lines were flagged as sampling locations. Sampling locations were revised from proposed locations shown in the TSP (HLA, 1993a) based on field observations of usage patterns at the firing range. The surface soil samples (SM024SS001 through SM024SS017) were collected from 0.0 to 0.5 foot bgs. At each sampling location, 1 duplicate soil sample was collected. One sample was submitted to the laboratory for analysis of cyanide and total metals; the duplicate sample was analyzed by HLA field personnel for shot and bullet fragment content. Field procedures for evaluating the bullet fragment content of soil samples and the results are presented in Appendix J.

Soil Boring and Subsurface Soil Sampling

Subsurface soil samples were collected from 6 representative borings (SM024SB001 through SM024SB005 and SM024SB007) throughout the firing range on the basis of results of the screening survey discussed above. Soil Boring SM024SB007 replaced Soil Boring SM024SB006, which was collected in an incorrect location. These boring locations were collocated with 6 surface soil

sampling locations. Soil samples from each boring were collected every 0.5 foot from approximately 0.5 to 3.0 feet bgs using a hand auger. The 0.5- to 2.5-foot soil sample fraction was analyzed by HLA personnel to evaluate bullet and bullet fragment content using the same methods described for the surface soil samples. The 2.5- to 3.0-foot soil sample fraction was submitted to the laboratory for cyanide and total metals analysis to assess the mobility of metals in the soil. When hand augering Borings SM024SB003 and SM024SB004 during February 1994, refusal occurred prior to sampling these borings to the proposed depth of 3.0 feet bgs; therefore, subsurface soil samples were collected at depths shallower than those proposed in the TSP (HLA, 1993a). Three attempts were made at each of these locations to auger and sample down to 3 feet bgs. Apparently, refusal was due to the ground being frozen at those locations. All subsurface soil samples previously collected for shotgun shot and bullet fragment content analysis were recollected on April 6, 1994, because the initial set of samples were not analyzed according to the TSP (HLA, 1993a). Because the ground was not frozen at the time the samples were recollected, field personnel were able to collect soil samples for the shotgun shot and bullet fragment content analysis from Borings SM024SB003 and SM024SB004 at depths specified in the TSP. Instead of using a drive sampler with a split-spoon sampler to collect subsurface soil samples, as discussed in Appendix A of the TSP (HLA, 1993a), a stainless-steel hand auger was used to collect the soil samples due to the very poor sample recovery rate when using the drive sampler. Boring logs are presented in Appendix H.

4.13.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM24 are presented in the following subsections. The analytical results for analytes that exceed background concentrations are discussed separately for surface soil and subsurface soil. A summary of the bullet fragment analysis is presented in the following subsections.

4.13.2.1 Surface Soil Samples

Table 4.52 presents a summary of the analytical results for analytes detected in the surface soil samples at concentrations greater than IDEM background. Figure 4.40 shows the locations where the

surface soil samples were collected at this site. Figure 4.41 shows the analytical results of surface soil samples collected at this site that exceed IDEM background concentrations.

Metals

Metals with concentrations that exceeded IDEM background concentrations were detected in each of the surface soil samples collected at this site. Sixteen metals exceeded IDEM background concentrations at 1 or more of the sampling locations at this site. The number of metals in the 17 investigations and 2 duplicate surface soil samples that exceeded IDEM background ranged from 1 metal in Sample SM024SS011 to 11 metals in Sample SM024SS016. Lead was detected in each of the surface soil samples, and arsenic was detected in all but 1 of the investigative samples, although the arsenic result for surface soil Sample SM024SS010-Dup was qualified unacceptable during the independent data valuation, as were the selenium results. This firing range is used primarily for firing shotguns (at skeet), although rifles and pistols have been fired at this range. The rifle/pistol range is north of Building 822 (Figure 4.40). Lead concentrations of surface soil in the area north of Building 822 are high (120,000 mg/kg [SM024SS007] and 57,000 mg/kg [SM024SS008]) and are consistent with site usage as a skeet/rifle range. Many of the lead concentrations identified at this site exceed the EPA (1994c) recommended screening level for residential soil (400 ppm). However, samples collected near the boundary of the area sampled (e.g., SM024SS005 and SWM024SS007) contained elevated levels of lead and indicated the extent of metals concentrations at this site has not been completely identified.

Metals are naturally occurring elements, and their presence at the site is not necessarily related to the use of the site as a firing range. However, several metals (including antimony, copper, lead, and zinc) have been identified in the rounds used by the military at small arms ranges (Heath and others, 1991). The high concentrations of these metals in surface soil reflects use of the site as a firing range. Other metals identified as exceeding IDEM background (barium, cadmium, chromium, etc.) are not related to the use of the site as a firing range and probably occur naturally at the site. The

source of the high arsenic concentrations is not known. Arsenic has not been associated with small arms ranges (Heath and others, 1991); however, the concentrations appear to be too high for background.

4.13.2.2 Subsurface Soil Samples

Table 4.53 presents a summary of the analytical results for analytes detected in the subsurface soil samples at concentrations greater than IDEM background. Figure 4.40 shows the locations where the subsurface soil samples were collected at this site. Figure 4.42 shows the analytical results of subsurface soil samples collected at this site that exceeded IDEM background concentrations.

Metals

Metals concentrations that exceeded IDEM background concentrations were detected in all the subsurface samples collected from the 6 soil borings drilled at this site. Six metals exceeded IDEM background concentrations at 1 or more sampling locations at this site. The number of metals that exceeded IDEM background concentrations in subsurface soil samples collected from the 6 soil borings ranged from 1 in samples collected from Borings SM024SB001 and SM024SB005 (2.5-foot depth each) to 4 metals in samples collected from Borings SM024SB003 (0.8-foot depth) and SM024SB004 (2-foot depth). The selenium value for the subsurface soil sample collected from Soil Boring SM024SB003 was found to be unacceptable during independent data validation. Sodium was detected in 6 subsurface soil samples, and lead was detected in 3 subsurface soil samples at concentrations that exceeded IDEM background concentrations (Table 4.53). However, the lead concentrations in the subsurface samples collected at this site are less than EPA's 400 mg/kg screening level for lead in soil in residential areas (EPA, 1994c). Generally, the metals concentrations in the subsurface soil samples that exceed IDEM background are much lower than the respective metals concentrations in the surface soil.

4.13.2.3 Bullet Fragment and Shotgun Shot Analysis

Surface and subsurface soil samples collected at this site were analyzed for bullet, bullet fragment and shotgun shot content. The analysis procedures are described in Appendix J and results are included in Table 4.54. Generally, the percent of bullets, bullet fragments, and shotgun shot was greater in the surface soil samples than in the subsurface soil samples. The percent by weight of bullets, bullet fragments, and shotgun shot in surface soil samples ranged from 0.04 in surface soil Sample SM024SS011 to 18.75 in surface soil Sample SM024SS005. The percent by weight of bullets and bullet fragments in subsurface soil samples collected from this site ranged from 0.0 in several of the subsurface soil samples to 0.13 in Sample SM024SB005 (0.5 to 1.0-foot depth) (see Appendix J). The higher percentage of bullets, bullet fragments, and spent shot in the surface soil samples than in the subsurface soil samples is consistent with the use of this site as a skeet/rifle firing range.

4.13.3 Conclusions

On the basis of the investigation sampling and the results of the investigation at EI Site SM24, the following conclusions have been made for surface and subsurface soil:

- Surface soil metals concentrations exceeded IDEM background concentrations in all 17 sampling locations. The most frequently detected metal and the metal with the highest concentrations above IDEM background is lead. Many of the lead concentrations identified at this site exceed the EPA (1994) recommended screening level for residential soil (400 ppm).
- Subsurface soil metals concentrations exceeded IDEM background concentrations in 6 sampling locations. Sodium and lead were the most frequently detected metals, but at lower concentrations than in surface soil reflecting the impact of firing range activities on primarily the surface soil.

4.13.4 Recommendations

Phase II activities recommended for this site include additional sampling, risk assessment, and evaluation of possible remediation processes, as described below:

- Conduct field screening to delineate the extent of elevated lead concentrations in surface soil including possible locations of the site formerly used as a rifle range.
- Install monitoring wells and assess the effect of elevated metals on local groundwater quality.

- Conduct a risk assessment to evaluate risks associated with chemicals of concern at this site.
- Conduct an accelerated FS and implement interim remedial measures to remove the primary source of lead from the site.

4.14 EI Site SM25a: Historic Military Site

Historic military site EI Site SM25a is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment (Weston, 1992). Historic military site EI Site SM25a was identified during previous archaeological investigations at FBH as a World War I entrenchment, used for training activities from 1917 to 1918. In the archeological reports, this site is referred to as Site No. 12MA249.

4.14.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25a consisted of a records review and site reconnaissance. These activities are discussed in the following subsections.

4.14.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. The records search indicated that an archeological survey was performed by Indiana University (Bloomington, Indiana) in 1984. A subsequent survey was performed in 1992. The site consists of two parallel series of trenches located approximately 30 feet apart. The trenches were used as a training area during World War 1. These surveys indicated that artifacts were not observed or collected at the site. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The documents reviewed do not indicate that hazardous materials or hazardous substances were disposed of by the Army as waste materials at the site.

4.14.1.2 Site Reconnaissance

A site reconnaissance was performed to locate the site and evaluate its current physical condition. The site is located at the top of a hill in a wooded area. The site reconnaissance revealed parallel

trenches approximately 3- to 5-feet deep that were apparently used for troop training. Soil dug from the trenches was mounded along both sides of the trenches. Evidence of man-made surface debris or disposal of hazardous substances or waste materials was not observed in or near the trenches at this site. Photographs of this site are presented in Appendix L.

4.14.2 Conclusions

Based on the records review and site reconnaissance, there is no evidence to indicate that hazardous materials or hazardous substances as waste materials were disposed of by the Army at the World War I entrenchment site (EI Site SM25a) or that hazardous materials or hazardous substances were released.

4.14.3 Recommendations

No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.

4.15 EI Site SM25b: Historic Military Site

Historic military site EI Site SM25b is one of 12 historic military sites (Table 4.56) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment. During previous archaeological investigations at FBH, historic military site EI Site SM25b was identified as a World War I dump, in use from 1889 to 1913. In the archeological reports, this site is referred to as Site No. 12MA289. The site location is shown in Figure 4.43.

4.15.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25b consisted of a records review, site reconnaissance, geophysical survey, and investigation sampling. A summary of Phase I sampling rationale and locations at this site is provided in Table 4.56. These activities are discussed in the following subsections.

4.15.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. The records search indicated that an archeological survey was performed in 1983 and the survey indicated the presence of surface debris such as glass, whiteware, crockery, and porcelain fragments. A subsequent survey was attempted in 1992 but the surveyors could not relocate the site. The surveyors concluded that the site may have been destroyed during construction grading for the golf course fairway. The 1992 report indicated that 37 artifacts previously collected from the site were curated at USA-CERL, Champaign, Illinois. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review.

4.15.1.2 Site Reconnaissance

A site reconnaissance was performed to locate the site and evaluate its current physical condition. The site is located within the FBH golf course along the northeast edge of the fairway for the tenth hole. A portion of the site appears to be within a wooded area next to the fairway; the remainder of the site may be beneath the edge of the fairway turf. The site reconnaissance revealed the presence of a few glass fragments on the ground surface in the wooded portion of the site. No unusual ground features were observed. At the edge of this site, the ground surface may have been graded during construction of the golf course fairway, thus potentially burying debris. A hand auger was used to dig approximately 5 feet bgs at 1 location near the center of this site to evaluate the potential for buried debris. Buried debris was not observed in the soil cuttings from the hand-augured hole. A photograph of the general area of this site is presented in Appendix L.

4.15.1.3 Geophysical Survey

A limited geophysical survey consisting of EM profiling and GPR was conducted to evaluate whether waste materials at the site may have been buried during golf course construction. GPR was conducted where anomalies were identified using EM methods. The objective of the geophysical survey was to characterize the nature of the materials that may be buried and to identify the

dimensions of subsurface disturbances. The geophysical survey was conducted along parallel transects in a systematic method. The spacing of the transects varied depending on the relative size of the area being investigated. Geophysical surveying methods, equipment, and procedures are discussed in Appendix K.

4.15.1.4 Investigation Sampling

The field investigation sampling at EI Site SM25b consisted of the following activities:

- Collection and analysis of 6 surface soil samples and 1 duplicate surface soil sample

A broad suite of organic and inorganic analyses was performed on samples from this site because the types of contaminants possibly present in the surface soil samples collected at this site were not known. Soil samples were analyzed for SVOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters.

Surface Soil Sampling

Six surface soil samples (SM25bSS001 through SM25bSS006) were collected from historic military site EI Site SM25b to assess the potential for soil contamination. Surface soil samples were collected from the wooded portion of the site where glass fragments were observed on the ground surface. Sample locations are shown in Figure 4.43. The surface soil samples were collected from a depth of 0.0 to 0.5 foot bgs.

4.15.2 Results of Investigations

The results of the limited geophysical survey and investigation sampling are presented below.

4.15.2.1 Geophysical Survey

The limited geophysical survey for EI Site SM25b was performed for the portion of the site potentially located beneath the edge of the golf course fairway (Figure 4.43). No anomalous geophysical responses indicative of buried debris or fill material were noted within the portion of EI Site SM25b surveyed.

4.15.2.2 Surface Soil Samples

Table 4.57 presents a summary of the analytical results for analyte concentrations detected in the surface soil samples at concentrations greater than background surface soil concentrations. Detected concentrations of organic compounds and landfill parameters for which background levels have not been established are summarized in Table 4.58. Figure 4.43 shows the locations at which the surface soil samples were collected at this site. Figure 4.44 shows analytical results of surface soil samples collected at this site that exceeded background concentrations.

Metals

Metals concentrations that exceeded the IDEM background surface soil concentrations were detected in each of the 6 surface soil samples collected at EI Site SM25b. Nine metals including cadmium, cobalt, lead, and mercury IDEM background surface soil concentrations in surface soil samples from this site. The number of metal detections exceeding IDEM background surface soil concentrations ranged from 1 in Samples SM25BSS003, SM25BSS004, and SM25BSS06 to 6 in Sample SM25BSS001-DUP. Cobalt, lead, and zinc were detected in 3 surface soil samples each and were the metals most frequently detected in surface soil collected at this site at concentrations that exceeded IDEM background concentrations. Lead concentrations were well below the 400 mg/kg screening level for lead in residential soil (EPA, 1994c).

Metals are naturally occurring elements. Because of the relatively low concentrations of the metals exceeding IDEM background, the concentrations of analytes detected in the surface soil samples are likely the result of natural heterogeneity and are not related to site-specific activities.

Organics

Organic compounds were detected in 5 of the 6 surface soil samples collected at EI Site SM25b and in the duplicate sample. Twenty-two SVOC compounds, consisting of PAH compounds and several TICs, were detected among the 5 surface soil samples that had detects. The number of SVOCs detected in the surface soil samples ranged from 0 in surface soil Sample SM25BSS004 to 21 in

surface soil Sample SM25bSS001-DUP. The TIC nonacosane was detected in 6 surface soil samples and was the compound most frequently detected in surface soil samples. The detections for bis(2-ethylhexyl)phthalate are likely the result of laboratory contamination. The concentrations of the respective PAHs and TICs detected in the surface soil samples were less than 3.0 mg/kg.

All of the PAH compounds and many TICs, consisting primarily of hydrocarbons, were detected in the same surface soil samples (SM25BSS001) and confirmed by the duplicate sample. This suggests a small, localized source area that may have resulted from site-related activities, although PAH compounds and hydrocarbons are found in urban environments and may be the result of activities unrelated to the site.

One pesticide (beta-benzene hexachloride) was identified at low concentrations in 1 surface soil sample (SM25BSS003). The presence of this pesticide may be related to the basewide use of pesticides.

Landfill Parameters

Landfill parameter analytes were detected in each of the 6 surface soil samples and the duplicate sample. Four landfill parameter analytes were detected, including total organic carbon (TOC), ammonia, nitrate/nitrite, and total recoverable phenolics. Three landfill parameter analytes (ammonia, nitrite/nitrate, and TOC) were detected in each of the 6 samples and the duplicate sample. The range of values detected for ammonia is 129 mg/kg to 249 mg/kg. For TOC, it is 18,000 mg/kg to 44,000 mg/kg, and for nitrate/nitrate-nonspecific it is 3.19 mg/kg to 7.95 mg/kg. The presence of ammonia, nitrite/nitrate, and TOC is expected in soil samples. These analyses are not screened against background values and are common soil constituents.

4.15.3 Conclusions

On the basis of results of the records review, site reconnaissance, geophysical survey, and investigation sampling, the following conclusions have been made for EI Site SM25b:

- Information obtained from the records review revealed that surface debris (artifacts) were found during a 1983 archeological survey of this site; however, subsequent searches for artifacts failed because of possible grading of the site related to construction of the FBH golf course.

- HLA's site reconnaissance did not reveal the presence of manmade surface or subsurface debris, or evidence that this site was used for disposal of refuse.

- There was no evidence of buried debris detected during HLA's geophysical survey of this site.

- Results of the investigation sampling revealed the following:

  - Cadmium, cobalt, mercury, lead, and zinc were detected in surface soil samples at concentrations that slightly exceeded IDEM background concentrations. The presence of these analytes is not believed to be related to site activities.

  - Twenty-two SVOC compounds, including several PAHs and TICs, were detected in 5 of the 6 surface soil samples with all of the PAH compounds detected only in a single sample at low concentrations. The presence of these analytes may have been the result of post activity at this site.

  - One pesticide (beta-benzenehexachloride)was detected at low concentrations in 1 sample at the site. This pesticide may be related to the basewide use of pesticides.

  - Four landfill parameters (ammonia, nitrite/nitrate-nonspecific, TOC, and total recoverable phenolics) were detected for this site. The presence of these analytes is likely not related to site activities.

4.15.4 Recommendations

Phase II activities recommended for this site include additional sampling, background evaluation, and risk assessment as described below:

- A risk assessment should be conducted to evaluate risks associated with chemicals of concern, including detected PAHs, at the site.

4.16 EI Site SM25c: Historic Military Site

Historic military site EI Site SM25c is 1 of 12 historic military sites (Table 4.55) investigated as part of the Phase I EI because this site may have the potential for releasing hazardous substances into the environment. Historic military site EI Site SM25c was identified during previous archaeological investigations at FBH as a World War I-era dump, used from 1890 to 1920. In the archeological reports, this site was referred to as Site No. 12MA290. The site location is shown in Figure 4.43.

4.16.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25c consisted of a records review, site reconnaissance, geophysical survey, field screening, and investigation sampling. A summary of Phase I sampling rationale and locations at this site is provided in Table 4.59. These activities are discussed in the following subsections.

4.16.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. The records search indicated that an archaeological survey was performed in 1983. Two documents (Resource Analysis, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The archaeological survey indicated that the World War I dump was buried during golf course construction, but did not appear to be heavily disturbed. Further, the survey noted the presence of glass, porcelain, whiteware, and crockery fragments, an iron hinge, and slag. A subsequent survey was attempted in 1992 but the surveyors could not definitely relocate the site. These surveyors concluded that the site was probably removed during golf course construction. The 1992 report indicated that 19 artifacts previously collected from the site were curated at USA-CERL, Champaign, Illinois.

4.16.1.2 Site Reconnaissance

A site reconnaissance was performed to relocate the site and evaluate its current physical condition. The site is located within and adjacent to the fairway for the tenth hole at the FBH golf course, south and southeast of the tenth green (Figure 4.43).

The site reconnaissance revealed that the entire site is beneath the FBH golf course turf; therefore, surface debris was not observed, with one exception. A shallow subdrain pipe, located in the golf course fairway, was in the process of being repaired by FBH golf course maintenance personnel. Soil covering the subdrain pipe was excavated and stockpiled next to the pipe. Within the excavated soil

(less than 1 cubic yard), several glass bottle fragments were observed. Photographs of this site are presented in Appendix L.

4.16.1.3 Geophysical Survey

A geophysical survey consisting of EM profiling and GPR was conducted to evaluate whether waste materials were buried at the site during golf course construction. The objective of the geophysical survey was to characterize the materials that may have been buried and to identify the dimensions of subsurface disturbances. GPR was conducted where anomalies were identified using EM methods. The geophysical survey was conducted along parallel transects in a systematic method. The spacing of the transects varied depending on the relative size of the area being investigated.

4.16.1.4 Field Screening

Areas identified during the records review and geophysical survey as being potentially impacted by hazardous substances and accessible by vehicle were screened by performing a soil-gas survey.

Soil-Gas Survey

A soil-gas survey was conducted at EI Site SM25c as an initial screening of possible volatile constituents in the soil or groundwater on the basis of the records review and geophysical survey. The soil-gas survey was conducted on September 29 and September 30, 1993. Soil-gas samples collected from this site were analyzed for TVH and VOCs including methane.

4.16.1.5 Investigation Sampling

The field investigation sampling at EI Site SM25c consisted of the following activities:

- Collection and analysis of 10 subsurface soil samples from 5 soil borings, and 1 duplicate subsurface soil sample from 1 of the 5 soil borings

Soil samples collected from this site were analyzed for a broad suite of organic and inorganic analytes including VOCs, SVOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters.

Soil Borings and Subsurface Soil Sampling

Five soil borings (SM25CSB001 through SM25CSB005) were drilled and sampled at historic military site EI Site SM25c. This site was selected for drilling on the basis of soil-gas survey and geophysical survey results. Five borings were drilled at this site instead of the 3 originally proposed in the TSP (HLA, 1993a) due to the extent of the subsurface disturbances and the quantity of anomalies detected during the geophysical survey. The borings were drilled and sampled through fill material to approximately 5 feet beneath the fill, with the exception of Boring SM25CSB004, which was drilled to 28 feet bgs; fill is present to approximately 11 feet bgs. Boring SM25CSB004 was drilled to this depth because the interface between the fill and native soil was not apparent to the field geologist during drilling. Fill material was encountered at each of the 5 borings drilled to approximate depths of 3 to 10 feet bgs based on the presence of manmade debris (i.e., glass and porcelain fragments, wood chips, slag, pieces of metal, and possibly coal fragments). The greatest thickness of fill material was encountered at Boring Locations SM25CSB003 and SM25CSB004 within the tenth fairway of the golf course.

Soil samples were collected at approximately 2.5-foot intervals beginning at approximately 2.5 feet bgs unless poor sample recovery precluded the collection of samples from this sampling interval. Boring SM25CSB003 was continuously sampled to evaluate the heterogeneity of the fill material. Two soil samples were selected from each boring for chemical analysis except for 3 soil samples that were collected from Soil Boring SM25CSB001. The third sample from SM25CSB001 was treated as a duplicate sample. One sample was selected from the fill material and another sample was selected from the native soil immediately below the base of the fill material. The fill sample was selected on the basis of organic vapor analyzer/photoionization detector (OVA/PID) readings, soil discoloration, and/or other indications of contamination if observed.

Subsurface soil samples were submitted for analysis of SVOCs, VOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters. Boring logs are presented in Appendix H.

4.16.2 Results of Investigations

The results of the geophysical survey, field screening, and investigation sampling are presented below.

4.16.2.1 Geophysical Survey

The geophysical survey for EI Site SM25c indicated the presence of subsurface disturbances and several distinct anomalies. The extensive medium amplitude EM anomaly shown in Figure 4.43 is believed to be caused by increased soil moisture along a local drainage, and is not an indication of widespread subsurface disposal. The locations of numerous isolated high amplitude EM anomalies indicative of buried landfill material containing metal are also shown. In addition, a buried utility was detected in the southwest corner of the survey area.

4.16.2.2 Field Screening

Soil-Gas Survey

The soil-gas survey at EI Site SM25c included collecting soil-gas samples from 2 sample locations. Samples were collected at Locations S25C-01 and S25C-04 at 5.5 and 5 feet bgs, respectively. Neither TVHs or VOCs were detected in the soil-gas samples collected at these 2 locations. Soil-gas samples were to be collected at 3 additional locations, but soil at these locations proved to be of low permeability and thus, additional soil-gas samples could not be collected. Soil-gas survey results are presented in Appendix A.

4.16.2.3 Subsurface Soil Samples

Table 4.60 presents a summary of the analytical results for analytes detected in subsurface soil samples at concentrations greater than IDEM background subsurface soil concentrations. Detected concentrations of organic compounds and landfill parameters for which IDEM background has not been established are summarized in Table 4.61. Figure 4.43 shows the locations at which the subsurface soil samples were collected at this site. Figure 4.45 shows the analytical results of subsurface soil samples collected at this site that exceed IDEM background concentrations.

Metals

Metals concentrations that exceeded IDEM background subsurface soil concentrations were detected in subsurface soil samples collected from each of the 5 borings drilled at this site. Seventeen metals and cyanide exceeded the IDEM background subsurface soil concentrations in 1 or more subsurface soil samples collected from the 5 borings drilled at this site. The number of metals in the subsurface soil samples that exceeded the IDEM background concentrations ranged from 1 in the subsurface soil samples collected from Borings SM25CSB001 (4.5-foot depth) and SM25CSB004 (4.5-foot depth) to 11 in the subsurface soil sample collected from Boring SM25CSB003 (11.5-foot depth). Cobalt was the most frequently detected metal with 6 detections. Arsenic, lead, and zinc were the next most common with 5 detections each. Other metals including barium, chromium, and iron were each detected in up to 4 subsurface soil samples. All data for selenium were rejected during independent data validation. Cyanide was found in only 1 sample (SM25CSB004, 13-foot depth) at a concentration of 1.16 mg/kg.

Metals are naturally occurring elements. Because of the relative low concentrations of the metals exceeding background, the concentrations of the analytes detected in the soil samples may be the result of natural heterogeneity and may not be related to site-specific activities.

Organics

Organic compounds were detected in subsurface soil samples collected from each of the 5 borings drilled at this site (Table 4.61). However, the compounds identified are either not related to the site or are only tentatively identified. The bis(2-ethylhexyl) phthalate and di-n-butyl phthalate and 2 acetone detections were flagged "b" during data evaluation to indicate that these compounds were detected in associated method blanks and may be laboratory artifacts. The VOC trichlorofluoromethane, detected in Boring SM25CSB004 (13-foot depth), is used by the laboratory as a solvent. The presence of this compound in the subsurface soil sample collected from Boring SM25CSB004 (13-foot depth) at this site is not likely related to site-specific activity.

The number of compounds detected in the subsurface soil samples ranged from 1 in the subsurface soil samples collected from Boring SM25CSB004 (13-foot depth) to 8 in subsurface soil samples collected from Boring SM25CSB002 (4.5-foot depth). The TIC concentrations for subsurface soil samples collected from Boring SM25CSB002 were detected at concentrations of less than 1 mg/kg and consist primarily of hydrocarbons. However, as indicated above, Boring SM25CSB002 was drilled in fill material containing debris, including coal.

Landfill Parameters

Landfill parameter analytes were detected in surface soil samples collected from each of the 5 boreholes. The number of detected analytes ranged from 2 (SM25CSB001, 2-foot depth) to 4 detections (SM25CSB004, 13-foot depth). Ammonia, nitrite/nitrate, and TOC were detected in each of the 5 borings. Each value for fluoride and total recoverable phenolics was qualified with a "b" to indicate that this compound in this sample should be treated as a nondetection due to laboratory blank contamination. The analytes chloride, fluoride, and sulfate were compared to background data. The concentrations of these analytes in the respective subsurface soil samples did not consistently exceed IDEM background. Sulfate was detected in 3 borings at concentrations exceeding IDEM background. Chloride exceeded IDEM background in a sample collected from 1 boring (SM25CSB004, 13-foot depth).

4.16.3 Conclusions

On the basis of results of the records review, site reconnaissance, geophysical survey, field screening, and investigation sampling, the following conclusions have been made for EI Site SM25c:

- Information obtained from the records review revealed that surface debris (artifacts) were found during a 1983 archeological survey of this site; however, subsequent searches for artifacts failed because of possible grading of the site related to construction of the FBH golf course.

- The HLA site reconnaissance revealed that this site is beneath the current FBH golf course turf; artifacts were not located on the undisturbed surface, although glass bottle fragments were observed in excavated soil.

- The geophysical survey indicated the presence of subsurface disturbances and several distinct anomalies. The subsurface disturbances were probably the result of increased soil moisture along a local drainage. The distinct anomalies are likely the result of buried metallic objects.

- TVHC and VOCs were not detected in the limited quantity of soil-gas samples collected from this site.

- Several metals were detected above IDEM background concentrations in the subsurface soil samples. The presence of the elevated metals concentrations in the subsurface may not be associated with site-related activities.

- Organic compounds detected in the subsurface soil samples collected from this site may be laboratory artifacts or TICs. The TICs are primarily hydrocarbons and were detected in fill material.

- Several landfill parameters including ammonia, chloride, sulfate, nitrite/nitrate, and TOC were detected in subsurface soil. These analytes are common soil constituents and their presence was not unexpected.

4.16.4 Recommendations

Phase II activities recommended for this site include risk assessment and background evaluation as described below:

- A baseline risk assessment should be conducted to evaluate risks associated with chemicals of concern at the site.

4.17 EI Site SM25d: Historic Military Site

Historic military site EI Site SM25d is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment. Historic military site EI Site SM25d was identified during previous archeological investigations at FBH as an agricultural dump (circa 1900) and as a World War II-era dump in use from 1946 to 1947. In the archeological reports, this site was referred to as Site 12MA295.

4.17.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25d consisted of a records review and site reconnaissance. These activities are discussed in the following subsections.

4.17.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. Two documents (Resource Analysts, Inc., 1986 and D.E. Mc Gillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The site is a World War II-era dump site. The records search indicated that an archeological survey was performed in 1983 that identified that manmade debris consisting of glass, whiteware, crockery, linoleum, shingle fragments, and a spark plug was observed. A subsequent survey performed in 1992 indicated the presence of some 1960s-era junk car parts (i.e., bumpers, fender, tire) at a small dump site. The 1992 report indicated that 21 artifacts previously collected from the site were curated at USA-CERL, Champaign, Illinois. The records review did not indicate that hazardous materials or hazardous substances were disposed of as waste material by the Army at the site.

4.17.1.2 Site Reconnaissance

A site reconnaissance was performed to locate the site and evaluate its current physical condition. The site is located in the north training grounds within a wooded area. The site reconnaissance revealed the presence of some crockery fragments on the ground surface. The junk car parts (i.e., bumpers, fenders, tire) observed during a 1992 archeological survey were not observed during the site reconnaissance. Possibly the junk car parts have since been removed. No unusual ground features were observed. Photographs of this site are presented in Appendix L. No indication of the disposal of hazardous wastes or hazardous substances by the Army was observed during the site reconnaissance.

4.17.2 Conclusions

On the basis of the records review and site reconnaissance, only household debris has been identified at the site. Dump materials identified during the 1992 survey (automobile bumpers, fenders, tires, etc.) have apparently been removed. There is no evidence to indicate that hazardous materials or hazardous substances were disposed of by the Army at this site, because the minimal debris observed at this site appears to be household related.

4.17.3 Recommendations

No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.

4.18 EI Site SM25e: Historic Military Site

Historic military site EI Site SM25e is one of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment. Historic military site EI Site SM25e was identified during previous archeological investigations at FBH as the F.M. Kimberlain homestead (1866 to 1945) and as a World War II-era dump. In the archeological reports, this site was referred to as Site 12MA298.

4.18.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25e consisted of a records review and site reconnaissance. These activities are discussed in the following subsections.

4.18.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. The site is a 19th/20th century farmstead site. The records search indicated that an archeological survey was performed during 1983. This survey described various features such as ground surface depressions from former buildings, a former cistern, and a dump associated with the F.M. Kimberlain homestead. Artifacts observed during this survey included glass bottles, glass, porcelain, whiteware and crockery fragments, an enameled metal basin, brick and brick fragments, a metal hinge, and a drain tile fragment. A subsequent survey was attempted in 1992. The surveyors could not definitely relocate the site. The 1992 report indicated that 99 artifacts previously collected from the site were curated at USA-CERL, Champaign, Illinois. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The records review did not indicate disposal of hazardous waste or hazardous substances by the Army at the site.

4.18.1.2 Site Reconnaissance

A site reconnaissance was performed to evaluate the current physical condition of the site. The site is located in the northeast portion of the base in the north training grounds within a wooded area. The site reconnaissance revealed the presence of some crockery and painted porcelain fragments on the ground surface at the former F.M. Kimberlain homestead site. Also observed were some surface depressions and red bricks that may have been part of the old cistern. To the east of the former homestead site, a small dump site was observed next to an old dirt road that extends to Lee Road. The dirt road has not been used in years (based on the amount of overgrowth observed). Items observed at this small dump site included household debris such as wiring, pieces of wood, fiberglass, pieces of metal, an aluminum nail, and a ceramic fuse.

In addition, evidence of former outbuildings was observed within 100 yards of this site. This evidence included the remains of a concrete floor and footings and concrete bricks in a rectangular configuration that may have been used as foundations for former outbuildings. A small pile of bricks, concrete rubble, and soil was also nearby. It is not clear if these additional manmade features are a part of EI Site SM25e. Photographs of this site are presented in Appendix L.

No indication that hazardous materials or hazardous substances were disposed of as waste material by the Army at the site were observed during the site reconnaissance.

4.18.2 Conclusions

On the basis the records review and site reconnaissance, there is no evidence to indicate that hazardous materials or hazardous substances were disposed of as waste material by the Army at the site, or that hazardous substances were released into the environment because the debris observed at this site appears to be household related.

4.18.3 Recommendations

No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.

4.19 EI Site SM25f: Historic Military Site

Historic military site EI Site SM25f is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment. Historic military site EI Site SM25f was identified during archaeological investigations at FBH as a World War II-era dump in use during 1947. In the archeological reports, this site was referred to as Site 12MA301. The site location is shown in Figure 4.46.

4.19.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25f consisted of a records review, site reconnaissance, geophysical survey, field screening, and investigation sampling. A summary of Phase I sampling rationale and locations at this site is provided in Table 4.62. These activities are discussed in the following subsections.

4.19.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The records search indicated that an archeological survey was performed in 1983 that stated that lawn-differential grass growth appears to mark foundation outlines. Artifacts identified during this survey included 6 glass bottles. A subsequent survey performed in 1992 indicated that this site is beneath a paved parking lot between two modern barracks buildings and was probably destroyed and/or removed by the Army. The 1992 report indicated the 6 artifacts previously collected from the site were curated at FBH.

4.19.1.2 Site Reconnaissance

A site reconnaissance was performed to locate the site and evaluate its current physical condition. The site is located south of Lord Hall, in a parking lot paved with asphaltic concrete. Photographs of this site are presented in Appendix L.

4.19.1.3 Geophysical Survey

A geophysical survey consisting of EM profiling and GPR was conducted to evaluate whether waste materials may have been buried when the site was graded or paved over during parking lot construction. The objective of the geophysical survey was to characterize the nature of the materials that may be buried and to identify the dimensions of subsurface disturbances. The geophysical survey was conducted along parallel transects in a systematic method. The spacing of the transects varied depending on the relative size of the area being investigated. Geophysical methods, equipment, and procedures are discussed in Appendix K.

4.19.1.4 Field Screening

Areas identified during the records review and geophysical survey as being potentially impacted by hazardous waste or hazardous constituents, and also accessible by vehicle were screened by performing a soil-gas survey.

Soil-Gas Survey

A soil-gas survey was conducted at EI Site SM25f as an initial screening of possible volatile constituents in the soil or groundwater on the basis of a records review and geophysical survey. The soil-gas survey was conducted on September 29 and September 30, 1993. Soil-gas samples collected from each site were analyzed for VOCs including methane. Soil-gas sampling procedures are discussed in Appendix A of the TSP (HLA 1993a).

4.19.1.5 Investigation Sampling

The field investigation sampling at EI Site SM25f consisted of the following activities:

- Collection and analysis of 6 subsurface soil samples collected from 3 soil borings

A broad suite of organic and inorganic analytes was analyzed for at this site. Samples collected from each location were analyzed for VOCs, SVOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters.

Soil Borings and Subsurface Soil Sampling

Three soil borings (SM25FSB001 through SM25FSB003) were drilled and sampled at historic military site EI Site SM25f. This site was selected for drilling on the basis of the soil-gas survey and the geophysical survey results. The borings were drilled near anomalies identified during the geophysical survey. The borings were drilled and sampled through any fill material to a depth of approximately 5 feet beneath the fill. Fill material was encountered at each boring at approximate depths of 3.5 to 4.0 feet bgs based on the presence of manmade debris, such as plastic strips, concrete rubble, and the heterogeneous appearance of the soil.

Soil samples were collected at approximately 2.5-foot intervals beginning at approximately 2.5 feet bgs. Borings SM25FSB001 and SM25FSB002 were continuously sampled to evaluate the heterogeneity of the fill material. Two soil samples were selected from each boring for chemical analysis. One sample was selected from the fill material and another sample was selected from the native soil immediately below the base of the fill material. The fill sample was selected on the basis of OVA/PID readings, soil discoloration, and/or other indications of contamination, if observed.

When selected soil samples from Borings SM25FSB001 through SM25FSB003 were received by the laboratory for chemical analysis, the interior temperature of the shipping cooler containing the samples was determined to be above 4°C when checked by the laboratory's sample receiving personnel. Because the temperature of these samples exceeded 4°C (the maximum preservation temperature), sample integrity was invalidated. Therefore, replacement soil samples were collected by drilling supplemental borings SM25FSB01A through SM25FSB03A near the original boring

locations. Soil samples were submitted for analysis of SVOCs, VOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters. Soil boring logs are presented in Appendix H.

4.19.2 Results of Investigations

The results of the geophysical survey, field screening and investigation sampling are presented below.

4.19.2.1 Geophysical Survey

Four small areas showing high amplitude EM anomalies indicative of buried metal were detected within the 0.6 acre surveyed (Figure 4.46). An east-west trending storm sewer was also identified. Approximately 1.6 line miles or 8,490 line feet of geophysical data were obtained.

4.19.2.2 Field Screening

Soil-Gas Survey

The soil-gas survey at EI Site SM25f consisted of sampling activities at 16 sample locations. Samples were collected at Location S25F-06 at a depth of 5 feet and at Locations S25f-08, S25f-12, and S25f-15, at a depth of 3 feet. A replicate sample was collected at Location S25f-06. Several analytes were detected in soil-gas samples analyzed at this site, including tetrachloroethene (0.004 μg/l), trichoroethene (0.006 μg/l), and TVH (14 μg/l). The results are summarized in Table 4.63. At the remaining 12 locations, the soil proved to be of low permeability and soil-gas samples could not be collected. Soil-gas survey results are presented in Appendix A.

4.19.2.3 Subsurface Soil Samples

Table 4.64 presents a summary of the analytical results for analytes detected in subsurface soil samples at concentrations greater than the IDEM background, or where detections of organics were reported. Figure 4.46 shows the locations at which the subsurface soil samples were collected at this site. Figure 4.47 shows the analytical results of subsurface soil samples collected at this site that exceeded the IDEM background concentrations, or where detections of organics were reported.

Metals

Metals concentrations that exceeded IDEM background concentrations were detected in subsurface soil samples collected from the 3 borings drilled at this site. Ten metals exceeded IDEM background subsurface soil concentrations in the subsurface soil samples collected from the 3 borings drilled at this site. The number of metals detected in subsurface soil samples ranged from 1 in subsurface soil sample collected from Soil Boring SM25FSB01A (2-foot depth) to 9 metals detected in subsurface soil samples collected from SM25FSB02A (2.5-foot depth). Most of the metals exceeding IDEM background are associated with 2 samples, SM25FSB01A and SM25FSB02A. Metals are naturally occurring elements. Because of the relatively low concentrations of the metals exceeding IDEM background concentrations, the metals concentrations in the soil samples may be the result of natural heterogeneity and may not be related to site-specific activities.

Organics

Organic compounds were detected in the 3 subsurface soil samples collected from the 3 borings drilled at this site. Twenty-one organic compounds, including several PAH compounds, alpha- and gamma-chlordane and TICs, were detected with most of the detections from Boring SM25FSB03A. The number of analyte detections in the subsurface samples ranged from 1 in subsurface samples collected from Borings SM25FSB01A and SM25FSB03A to 15 in a subsurface soil samples collected from Boring SM25FSB03A. The acetone values for subsurface soil samples collected from Borings SM25FSB02A and SM25FSB03A are qualified "b" to indicate that this compound was undetected because of laboratory blank contamination (see Table 4.65). PAH and TIC concentrations in the subsurface soil sample collected from Boring SM25FSB03A (3-foot depth) are less than 1 mg/kg. This sample was collected in fill material. Pesticide results for DDD, DDE, and alpha-chlordane in subsurface soil Sample SM25FSB03A (3-foot depth) were found unacceptable during independent data validation. The detection of pesticides with acceptable values may not be the result of site-specific activity, but instead may be related to the former basewide use of these chemicals for general insect control.

Landfill Parameters

Landfill parameters were detected in samples collected from each of the 3 soil borings. Ammonia was only detected in the 3 samples collected from borehole depth of 3 feet and less. TOC concentrations were similar in 5 samples, while the TOC concentration in Sample SM25FSB02A (2.5-foot depth) was less by a factor of 10. The pH reading for the 6 soil samples were rejected during the independent data validation. However, this rejection does not affect the evaluation of this site. Chloride and sulfate were detected above IDEM background in the 4 soil samples from Borings SM25FSB02A and SM25FSB03A. Fluoride was detected above IDEM background in 3 of the 6 soil Samples (SM25FSB01A, 7.5-feet; SM25FSB02A, 2.5- and 6.5-foot depth).

4.19.3 Conclusions

On the basis of results of the records review, site reconnaissance, geophysical survey, field screening, and investigation sampling, the following conclusions have been made for EI Site SM25f:

- The HLA site reconnaissance revealed that this site is beneath a paved parking lot south of Lord Hall Building.
- The geophysical survey indicated the presence of four anomalies indicative of buried metal.
- Low concentrations (<0.01 $\mu g/l$) of VOCs and TVH (<20 $\mu g/l$) were detected in the limited quantity of soil-gas samples collected from this site.
- Ten metals exceeding IDEM background were detected in subsurface soil samples collected from this site. Metals are naturally occurring elements, and may not be related to disposal activities at the site.
- Twenty-one organic compounds, including pesticides and PAH compounds were detected in the subsurface soil samples, collected at this site, composed primarily of fill.
- Landfill parameters were detected in the subsurface soil samples collected from the 3 borings at this site. The detections of these landfill parameters is expected because the landfill parameters are common constituents in soil.

4.19.4 Recommendations

Phase II activities recommended for this site include a baseline risk assessment and background evaluation, as described below:

- Conduct a risk assessment to evaluate risks associated with chemicals of concern at the site.

4.20 SI Site SM25g: Historic Military Site

Historic military site EI Site SM25g is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment. Historic military site EI Site SM25g was identified during previous archeological investigations at FBH as a World War I-era entrenchment used for training activities from 1917 to 1918. In the archeological reports, this site was referred to as Site 12MA302.

4.20.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25g consisted of a records review and site reconnaissance. These activities are discussed in the following subsections.

4.20.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The records search indicated that an archeological survey was performed in 1983. This survey describes the site as consisting of 2 parallel rows of trenches, including squad trenches, traverses, passages, and parapets. Portions of the trenches were completely filed in. No artifacts were observed during the 1983 survey. A subsequent survey performed in 1992 indicated that no artifacts were observed. Neither report indicates disposal of hazardous substances at the site.

4.20.1.2 Site Reconnaissance

A site reconnaissance was performed to evaluate the current physical conditions of the site. The site is located in the north training grounds within a wooded area. During the site reconnaissance, a series of northeast-southwest trending entrenchments were observed. These entrenchments were approximately 1 to 3 feet deep; soil dug from the trenches was mounded along both sides of the trenches. Evidence of manmade surface debris or that hazardous materials or hazardous substances

were disposed of by the Army as waste materials was not observed in or near the trenches at this site. Photographs of this site are presented in Appendix L.

4.20.2 Conclusions

On the basis of the records review and site reconnaissance, there is no evidence to indicate that hazardous materials or hazardous substances were disposed of by the Army as waste materials at this site.

4.20.3 Recommendations

No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.

4.21 EI Site SM25h: Historic Military Site

Historic military site EI Site SM25h is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous waste or hazardous constituents into the environment. Historic military site EI Site SM25h was identified during previous archeological investigations at FBH as a prehistoric (Native American) campsite and a military dump in use from 1930 to 1950. In the archeological report, this site was referred to as Site 12MA307. The site location is shown in Figure 4.48.

4.21.1 Investigation Activities Performed

The evaluation of the historic military site EI Site SM25h consisted of a records review, site reconnaissance, and investigation sampling. A summary of Phase I sampling rationale and locations at this site is provided in Table 4.66. These activities are discussed in the following subsections.

4.21.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review.

The records search indicated that an archeological survey was performed in 1983 that stated the site consists of materials bulldozed over the side of a hill. During the 1983 survey, artifacts observed at the site included a glass bottle, glass and whiteware fragments, and a carbon rod. During 1986/1989, an additional survey was performed that identified more dumping of recent blocks of concrete, brick, and miscellaneous construction debris. A prehistoric component of this site reportedly extends beneath the modern landfill. The 1986/1989 survey reported a prehistoric component of this site consisted of a very light scatter of chert debris along the slope and a small portion of the westward knob to the stream. Reportedly, most of the prehistoric component of the site was disturbed by the recent dump, although the portion within the wooded area to the west of the landfill appears to be undisturbed.

A subsequent survey performed in 1992 indicated the presence of a much larger dump than the dump cited in a previous survey. Artifacts collected during an earlier survey were curated at FBH.

4.21.1.2 Site Reconnaissance

A site reconnaissance was performed to locate the site and evaluate its current physical condition. The site is located west, northwest, and north of SWMU #FBH17 (Building 518) near the edge of a wooded area. The site reconnaissance revealed the presence of construction debris, predominantly large concrete blocks in addition to bricks, asphalt roofing, metal bars, some ceramic, electric wire insulators, and pieces of wood. It appears that the debris was dumped on the ground surface along the edge of a bluff. As dumping continued, the debris generally followed the outline of the bluff. South of the construction debris, some glass bottles and fragments, metal cans, and bricks were observed on the ground surface. Excluding the surface debris, no other unusual ground features were observed. Because the site is wooded and is obstructed by construction debris, a geophysical survey was not conducted. Photographs of this site are presented in Appendix L.

4.21.1.3 Investigation Sampling

The field investigation sampling at EI Site SM25h consisted of the following activities:

- Collection and analysis of 6 surface soil samples to assess the potential for contamination.

A broad suite of organic and inorganic analytes was analyzed for at these sites. Samples collected from each site were analyzed for SVOCs, metals, and landfill parameters.

Surface Soil Sampling

Six surface soil samples (SM25hSS001 through SM25hSS006) were collected from historic military site EI Site SM25h to assess the potential for soil contamination from the construction debris that was dumped at this site. The surface soil samples were collected from a depth of 0.0 to 0.5 feet bgs. Sample locations are shown in Figure 4.48.

4.21.2 Results of Investigations

The results of the investigation sampling are presented below.

4.21.2.1 Surface Soil Samples

Table 4.67 presents a summary of the analytical results for analytes detected in the surface soil samples at concentrations greater than the IDEM background surface soil concentrations. Detected concentrations of organic compounds and landfill parameters for which background data are not available are summarized in Table 4.68. Figure 4.48 shows the locations at which the surface soil samples were collected at this site. Figure 4.49 shows the analytical results of surface soil samples collected at this site that exceed the IDEM background concentrations or where organic compounds or landfill parameters were detected.

Metals

Metals concentrations that exceeded IDEM background surface soil concentrations were detected in each of the 6 surface soil samples collected at EI Site SM25h. Twelve metals exceeded IDEM background concentrations at 1 or more of the surface soil sampling locations at this site. The number of

analyte detections in the 6 surface soil samples that exceeded IDEM background surface soil concentrations ranged from one in surface soil Sample SM25HSS003 to 11 in surface soil Sample SM25HSS005. Nine metals were identified in surface soil Sample SM25HSS001. Lead, at concentrations lower than EPA's 400 mg/kg screening level for soil in residential areas (EPA, 1994c) was detected in each of the 6 surface soil samples and was the metal most frequently detected in surface soil samples. Zinc was detected above IDEM background in 5 surface soil samples.

Metals are naturally occurring elements. Because of the relatively low concentrations of several of the metals exceeding IDEM background, the concentrations of the metals detected in the soil samples may be the result of natural heterogeneity, and may not be related to site-specific activities.

Organics

Organic compounds were detected in each of the 6 surface soil samples collected at EI Site SM25h. Thirty-two compounds consisting primarily of PAH compounds, 1 phthalate compound, pesticides (DDT and DDE), and several TICs, consisting primarily of hydrocarbons, were detected at 1 or more of the sampling locations at this site. The number of compounds detected in the 6 surface soil samples ranged from 5 in surface soil Sample SM25HSS001, 18 in surface soil Sample SM25HSS002, to 22 in surface soil Sample SM25HSS003. One detection each of bis(2-ethylhexyl)phthalate and of gamma-chlordane were qualified with "b" during the independent data review to indicate these compounds were considered undetected because of laboratory blank contamination. The PAH compounds benzo(b)fluoranthene, fluoranthene, and pyrene were detected in 5 surface soil samples and were the compounds most frequently detected in surface soil samples. However, other compounds including the PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, ideno[1,2,3-c,d]pyrene, and phenanthrene were all detected in 4 of the 6 surface soil samples. The PAHs and hydrocarbons are associated with POL or combustion of POL products, and may, based on the number and concentrations of organic compounds detected, be related to disposal activities at the site. The extent of the organic compounds in soil has not been established.

Landfill Parameters

Landfill parameter analytes were detected in 1 or more samples from each of the 6 sample locations at the EI Site SM25h. The number of detections (some above background) ranged from 4 detections in Samples SM25HSS02, SM25HSS003, SM25HSS04, and SM25HSS006 to 6 detections in the surface soil Sample SM25HSS001. The 6 reported values for the pH measurements were rejected during the independent data review. However, these rejections have no impact on the evaluation of the site. Total recoverable phenolics were detected in 5 surface samples collected at this site. The detections are 6.79 mg/kg or less. Individual phenols were not detected during the SVOC analyses. Therefore, the detections of total recoverable phenolics are not good evidence for the presence of phenolic target analytes in the surface soil samples collected from this site. Ammonia and nitrate/ nitrite were detected in each of the 6 samples. Chloride was detected in the surface soil Samples SM25HSS001 and SM25H005, and sulfate was detected in surface soil Samples SM25HSS001 and SM25HSS004. Similar results of TOC, ranging from 20,000 to 62,000 mg/kg, were detected in all 6 surface soil samples. Detections of landfill parameters was anticipated in that the landfill parameters are common soil constituents.

4.21.3 Conclusions

On the basis of results of the records review, site reconnaissance, and investigation sampling, the following conclusions have been made for EI Site SM25h:

- Information obtained from the records review revealed that this site served as a prehistoric campsite. During the approximate time period between 1930 and 1950, this site served as a dump.
- The HLA site reconnaissance indicated the presence of construction debris on the ground surface along the edge of a bluff located at this site.
- Twelve metals were detected in surface soil samples at concentrations that exceeded IDEM background concentrations. Lead concentrations were below EPA's (1994c) action level for soil in residential areas (400 ppm). Some of the metals identified may not be related to onsite dumping actions.
- Primarily PAH and hydrocarbon compounds were detected in the 6 surface soil samples collected at this site; the extent of the organic compounds in surface soil has not been established.

- Between 3 and 5 landfill parameters were detected in each soil sample. The detections of landfill parameters were anticipated because many of the landfill parameters are common soil constituents.

4.21.4 Recommendations

Phase II activities recommended for this site include additional sampling, background evaluation, and risk assessment as described below:

- Collect additional surface and subsurface soil samples to assess the extent of the area where surface soil PAHs have been identified.
- Conduct a risk assessment to evaluate risks associated with chemicals of concern at the site.

4.22 EI Site SM25i: Historic Military Site

Historic military site EI Site SM25i is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment. Historic military site EI Site SM25i was identified during previous archeological investigations at FBH. In the archeological reports, this site was referred to as Site 12MA318. The site location is shown in Figure 4.50.

4.22.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25i consisted of a records review, site reconnaissance, geophysical survey, and investigation sampling. A summary of Phase I sampling rationale and locations at this site is provided in Table 4.69. These activities are discussed in the following subsections.

4.22.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The records search indicated that an archeological survey was performed in 1984. The report from the 1984 survey stated that there was a scatter of debris and a concrete pad, possibly related to water

treatment facilities once located near this location. Artifacts observed during this study included glass, coal fragments, wire nails, and an iron door hinge. A subsequent survey was performed in 1992 that did not include any new information.

4.22.1.2 Site Reconnaissance

A site reconnaissance was performed to locate the site and evaluate its current physical condition. The site is located west-northwest of the officer family housing area west of Building 654 in a grassy area that is regularly mowed (Figure 4.50). Potentially, this site could have been graded, thus burying possible surface debris. No surface debris or manmade structures were observed during the site reconnaissance; in addition, no unusual ground features were observed. Photographs of this site are presented in Appendix L.

4.22.1.3 Geophysical Survey

A geophysical survey consisting of EM profiling and GPR was conducted to evaluate whether waste materials may have been buried at the site. The objective of the geophysical survey was to characterize the nature of the materials that may be buried and to identify the dimensions of subsurface disturbances. The geophysical survey was conducted along parallel transects in a systematic fashion. The spacing of the transects varied depending on the relative size of the area being investigated. Geophysical surveying methods, equipment, and procedures are discussed in Appendix K.

4.22.1.4 Investigation Sampling

The field investigation sampling at EI Site SM25i consisted of the following:

- Collection and analysis of 6 surface soil samples

A broad suite of organic and inorganic analytes was analyzed for at these sites. Samples collected from each site were analyzed for SVOCs, metals, and landfill parameters. A description of the field investigation sampling activities follows.

Surface Soil Sampling

Six surface soil samples (SM25iSS001 through SM25iSS006) were collected from historic military site EI Site SMSM25i. Surface soil samples were collected from this site on the basis of the results of the geophysical survey showing potential subsurface disturbance(s) (but no anomalies) and/or surface debris.

At EI Site SM25i, the ground surface may have been graded, thus potentially burying debris. Therefore, a hand auger was used to dig down approximately 5 feet bgs at 1 location near the center of the site to evaluate the potential for buried debris. Buried debris was not observed in the soil cuttings during the hand augering of the boring at this site.

4.22.2 Results of Investigations

The results of the geophysical survey and investigative sampling are presented below.

4.22.2.1 Geophysical Survey

Anomalous EM or M-Scope responses indicative of subsurface metal debris were not observed at this site. A buried utility was detected along the west side of the survey area. GPR records show a 60- by 170-foot zone of disturbed soil in the upper few feet possibly indicative of subsurface disposal or imported fill material (Figure 4.50). Approximately 13,200 line feet or 2.5 line miles of geophysical data were obtained in the 1-acre survey area.

4.22.2.2 Surface Soil Samples

Table 4.70 presents a summary of the analytical results for analytes detected in the surface soil samples at concentrations greater than IDEM background surface soil concentrations. Detected concentrations of organic compounds and landfill parameters for which IDEM background values are not available are summarized in Table 4.71. Figure 4.50 shows the locations at which surface soil samples were collected at this site. Figure 4.51 shows the analytical results that IDEM exceed background concentrations for surface soil samples collected at this site.

Metals

Metals concentrations that exceeded the IDEM background were detected in 3 of the surface soil samples collected at EI Site SM25i (Table 4.70). Cobalt was detected in surface soil Sample SM25ISS005 at a concentration of 9.14 mg/kg, which is less than 1 mg/kg above IDEM background concentrations. Sodium and zinc were detected at concentrations slightly above IDEM background in Samples SM25ISS002 and SM25ISS003, respectively. Because of the small number and low concentrations of metal analytes detected in surface soil samples collected from this site, site-specific activities do not appear to have influenced metals concentrations in the surface soil. Metals detections are likely the result of natural soil heterogeneity.

Organics

Organic compounds were detected in each of the surface soil samples collected at EI Site SM25i. Eighteen compounds consisting primarily of PAH compounds, pesticides (DDT, DDD, and DDE), and several TICs were detected at 1 or more of the sampling locations at this site. The number of compounds in the 6 surface soil samples ranged from 3 in surface soil Samples SM25ISS004 to 18 in surface soil Sample SM25ISS001. DDE and the TIC nonacosane each were detected in all 6 surface soil samples and were the compounds most frequently present in surface soil samples at concentrations that exceeded background surface soil concentrations. The compounds, bis(2-ethylhexyl)phthalate and di-n-butyl phthalate, were qualified with "b" to indicate these compounds should be considered undetected because of laboratory blank contamination. The PAH compounds detected at concentrations greater than background surface soil concentrations were detected in only 1 surface soil sample collected from surface soil sampling Location SM25iSS001 at concentrations that were less than 2 mg/kg. The surface soil Sample SM25ISS001 may be fill material (see Appendix G for surface soil sample descriptions), the origin of which is not known. Materials common in the fill (e.g., coal, ash, etc.) may contribute to the observed PAH compounds. DDT was detected in 5 of the 6 surface soil samples, DDD was detected in 1 of the 6 surface soil samples, and DDE was detected in

all 6 surface soil samples at concentrations of less than 0.1 mg/kg. DDT, DDD, and DDE are likely to be the result of the historic basewide use of pesticides to control insects.

Landfill Parameters

Landfill parameters were detected in each of the surface soil samples collected at EI Site SM25i. Three analytes (ammonia, nitrite/nitrate, and TOC) were detected in all 6 samples. The ammonia values ranged from 86 mg/kg to 320 mg/kg. The 6 nitrite/nitrate-nonspecific values ranged from 3.15 mg/kg to 6.74 mg/kg. The 6 values for TOC ranged from 28,000 mg/kg to 58,000 mg/kg. Five of the 6 values for total recoverable phenolics were qualified with a "b" to indicate that this compound for these samples should be considered undetected because of laboratory blank contamination. The 1 value for chloride also was qualified with a "b" and likewise should be considered undetected. The sole acceptable detection for total recoverable phenolics was for Sample SS25ISS001 with a concentration of 4.27 mg/kg. However, phenolic compounds were not detected during semivolatile analysis of this sample, making the total phenolic detection questionable. All values for the pH were rejected as unacceptable and qualified with an "rr" during independent data validation. Detectable concentrations of landfill parameters including ammonia, nitrate/nitrite, and TOC are expected because these analytes are common constituents in soil.

4.22.3 Conclusions

On the basis of results of the records review, site reconnaissance, geophysical survey, and investigation sampling, the following conclusions have been made for EI Site SM25i:

- Information obtained from the records review revealed that a water treatment facility was once located near this site.
- The HLA site reconnaissance did not reveal the presence of man-made surface debris or evidence of unusual ground features.
- The geophysical survey revealed an area of disturbed soil possibly indicative of subsurface disposal or fill material.
- Cobalt, sodium, and zinc were detected in 1 surface soil sample each at concentrations slightly above IDEM background. These concentrations reflect soil heterogeneity and are not site related.

- PAH compounds were detected in 1 of the 6 surface soil samples collected at this site at concentrations of less than 2 mg/kg and may be related to fill material placed at the site. The extent of the PAH compounds has not been determined. DDE and the TIC nonacosane were detected in all 6 samples at concentrations of less than 2 mg/kg. DDT and DDD were detected in 1 or more samples at concentrations of less than 0.1 mg/kg and is probably related to former basewide use of pesticides.

- The landfill parameter analytes, ammonia, nitrite/nitrate, and TOC, were detected in all 6 surface soil samples. However, the detections and concentrations are likely not related to site-specific activities.

4.22.4 Recommendations

Phase II activities recommended for this site include additional investigative sampling of background evaluation and risk assessment as described below:

- Additional surface and subsurface soil sampling should be performed to assess the extent of PAH compounds at the site.

- A risk assessment should be conducted to evaluate risks associated with chemicals of concern at the site.

4.23 EI Site SM25j: Historic Military Site

Historic military site EI Site SM25j is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the environment. Historic military site EI Site SM25j was identified during archeological investigations at FBH as a military dump (World War I, circa 1908+). In the archeological reports, this site was referred to as Site 12MA319. The site location is shown in Figure 4.50.

4.23.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25j consisted of a records review, site reconnaissance, geophysical survey, and investigation sampling. A summary of Phase I sampling rationale and locations at this site is provided in Table 4.72. These activities are discussed in the following subsections.

4.23.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The records search indicated that an archeological survey was performed in 1984. The report from the 1984 survey stated that a light scatter of historic debris was behind the row of military family residences on Lawton Avenue. The historic debris is exposed mostly in garden plots. Artifacts observed during this study included glass, plastic, and a brass cartridge. A subsequent survey performed in 1992 found no surface indications of the site. The artifacts collected during the 1984 survey are curated at FBH.

4.23.1.2 Site Reconnaissance

A site reconnaissance was performed to locate the site and evaluate its current physical condition. The site is located west of the officer family housing area west of Buildings 645 and 646 in a grassy area that is regularly mowed. Potentially, this site could have been graded, thus burying possible surface debris. No surface debris was observed during the site reconnaissance; in addition, no unusual ground features were observed. At this site, the ground surface may have been graded, thus potentially burying debris. Therefore, a hand auger was used to dig down approximately five feet bgs at one location near the center of the site to evaluate the potential for buried debris. Buried debris was not observed in the soil cuttings during the hand augering of the boring at this site. Photographs of this site are presented in Appendix L.

4.23.1.3 Geophysical Survey

A geophysical survey consisting of EM profiling and GPR was conducted to evaluate whether waste materials have been buried at the site. The objective of the geophysical survey was to characterize the nature of the materials that may be buried and to identify the dimensions of subsurface disturbances. The geophysical survey was conducted along parallel transects in a systematic fashion.

The spacing of the transects varied depending on the relative size of the area being investigated. Geophysical surveying methods, equipment, and procedures are discussed in Appendix K.

4.23.1.4 Investigation Sampling

The field investigation sampling at the EI Site SM25j consisted of the following:

- Collection and analysis of 6 surface soil samples and 1 duplicate surface soil sample

Samples collected from each site were analyzed for a broad suite of organic and inorganic analytes including SVOCs, metals, and landfill parameters. A description of the field investigation sampling activities follows.

Surface Soil Sampling

Six surface soil samples (SM25JSS001 through SM25JSS006) were collected from historic military site EI Site SM25j to assess the potential for soil contamination from the construction debris that was observed at this site. The surface soil samples were collected from a depth of 0.0 to 0.5 foot bgs. Sample locations are shown in Figure 4.50. Surface soil sampling procedures are discussed in the TSP (HLA, 1993a). Surface soil samples were collected from this site on the basis of the results of the geophysical survey showing potential subsurface disturbances (but no anomalies).

4.23.2 Results of Investigations

The results of the geophysical survey, and investigation sampling are presented below.

4.23.2.1 Geophysical Survey

GPR profiles obtained at this site show 3 localized areas of shallow disturbed soil indicative of fill material or possible subsurface disposal (Figure 4.50). EM and M-Scope surveys were not effective at this site due to interference from 6 buried utilities within the 0.25-acre survey area. Approximately 3900-line feet or 0.75-line miles of geophysical data were obtained at this site.

4.23.2.2 Surface Soil Samples

Table 4.73 presents a summary of the analytical results for analytes detected in the surface soil samples at concentrations greater than IDEM background surface concentrations. Detected values of organic compounds and landfill parameters for which IDEM background values are not available are summarized in Table 4.74. Figure 4.50 shows the locations at which the surface soil samples were collected at this site. Figure 4.51 shows the analytical results that exceed IDEM background concentrations for surface soil samples collected at the site.

Metals

Metals with concentrations that exceeded the IDEM background surface soil concentrations were detected in 4 of the 6 investigative and 1 duplicate surface soil samples collected at EI Site SM25j. Eight metals exceeded IDEM background concentrations in 1 or more surface soil samples collected at this site. Of the samples where metals were detected, Sample SM25JSS003 had the least number of analytes detected (1 metal, cobalt). With 7 detections, Sample SM25JSS005 had the most analytes detected. Copper and zinc were each detected in 3 surface soil samples and were the most frequently detected analytes at concentrations that exceeded background surface soil concentrations. Lead was identified as exceeding background in 2 surface soil samples. However, the detected concentrations of lead were much less than the EPA's 400 mg/kg screening level for lead (EPA, 1994c). Several of the metals concentrations identified in Table 4.73 only slightly exceed IDEM background values. The presence of these metals at the concentrations detected is likely the result of natural heterogeneity of the soil and not related to site-specific activities.

Organics

Organic compounds were detected in each of the 6 surface soil samples collected at EI Site SM25j. Twenty-three compounds, consisting of PAH compounds, pesticides, and the TICs nonacosane, palmitic acid, and r-sitosterol, were detected at 1 or more of the surface soil sampling locations at this site. The number of detected compounds in the 6 surface soil samples ranged from 2 in surface soil Sample SM25JSS001D to 18 in surface soil Sample SM25JSS004. The compound

bis(2-ethylhexyl)phthalate was reported in all 6 of the surface soil samples and the 1 duplicate sample, but all 7 detections were qualified "b" to indicate these results should be considered nondetections because of laboratory blank contamination. Likewise, all 3 di-n-butyl phthalate reported values were qualified and disregarded. The TIC nonacosane and the PAH compounds benzo[b]fluoroanthene, fluoroanthene, and pyrene were the compounds most frequently detected in surface soil samples. These compounds all had concentrations less than 5 mg/kg. The PAH compounds benzo(a)pyrene; chrysene; indeno(1,2,3-cd)pyrene; and phenanthrene were each detected in 3 surface soil samples. The pesticides DDT, DDD, and DDE were each detected in 2 surface soil samples. The presence of these pesticides is likely the result of the historic basewide use of DDT and is not related to known site-specific activities. Although the PAH compounds and TICs had low concentrations, the number of organic compounds detected in surface soil samples and the locations of the surface soil samples collected at this site indicate that the extent of low-concentration organic compounds in surface soil samples has not been defined.

Landfill Parameters

Landfill parameter analytes including ammonia, chloride, nitrite/nitrate, TOC, and total recoverable phenolics were detected in each of the 6 surface soil samples at EI Site 25j. Chloride was the least common analyte and was found in only 1 sample (SM25J004). Total recoverable phenolics were detected in 2 samples (SM25JSS001 and SM25JSS003) at concentrations between 4.32 mg/kg and 8.02 mg/kg. Two other reported values for this analyte were qualified during independent data validation with a "b" for laboratory blank contamination and should be considered as nondetections. Two analytes (pH and fluoride) had all of their reported values qualified or rejected with either a "b" for laboratory blank contamination or an "rr" for other reasons during independent data validation. As such, there is no acceptable data for these analytes. The presence of landfill parameters in the surface soil samples is expected because they are common soil constituents and may be related to previous site activities.

4.23.3 Conclusions

On the basis of results of the records review, site reconnaissance, geophysical survey, and investigation sampling, the following conclusions have been made for EI Site SM25j.

- Information obtained from the records review indicated that this site served as a World War I-era dump site. A limited amount of surface debris has been recovered mostly in garden plots from this site.
- The HLA site reconnaissance did not indicate the presence of manmade surface debris or evidence of unusual ground features.
- The geophysical survey indicated 3 localized areas of shallow disturbed soil possibly indicative of subsurface disposal or fill material.
- Copper and zinc were each detected in 3 surface soil samples at concentrations that exceeded the IDEM background concentration. Lead was identified as exceeding IDEM background in the surface samples; however, the concentrations were below the EPA (1994c) action level for soil in residential areas. The presence of metals is not related to known site-specific activities.
- Twenty-three organic compounds including PAH, TIC, and pesticide compounds were detected in 1 or more of the 6 surface soil samples collected at this site at concentrations of less than 5 mg/kg. The presence of organic compounds may be related to site disposal activity. The extent of low-concentration organic compounds in surface soil has not been defined.
- Landfill parameter analytes including ammonia and TOC were detected in 1 or more of the 6 surface soil samples collected at this site. The presence of landfill parameter analytes is not related to known site-specific activities.

4.23.4 Recommendations

Phase II activities recommended for this site include background evaluation, additional sampling, and risk assessment, as described below:

- Conduct additional surface and subsurface soil sampling to assess the extent of PAH compounds at the site.
- A risk assessment should be conducted to evaluate risks associated with chemicals of concern at this site.

4.24 EI Site SM25k: Historic Military Site

Historic military site EI Site SM25k is 1 of 12 historic military sites (Table 4.55) investigated as part of the EI at FBH because this site may have the potential for releasing hazardous substances into the

environment. Historic military site EI Site SM25k was identified during previous archeological investigations at FBH as a military dump (World War II, circa 1933+). In the archeological reports, this site is referred to as Site 12MA320. The site location is shown in Figure 4.52.

4.24.1 Investigation Activities Performed

The evaluation of historic military site EI Site SM25k consisted of a records review, site reconnaissance, and investigation sampling. A summary of Phase I sampling rationale and locations at this site is provided in Table 4.75. These activities are discussed in the following subsections.

4.24.1.1 Records Review

A records review was performed to characterize historical site use and potential for contamination. Two documents (Resource Analysts, Inc., 1986 and D.E. McGillem & Associates, Inc., 1990) and the files of FBH Environmental Coordinator, Mr. Tom Shafer, were researched for the records review. The records search indicated that an archeological survey was performed in 1984 by Indiana University. The 1984 survey report stated that the site is a dump scattered along the edge of and in a depression. This depression is probably the result of Army earth moving activities, is approximately 65 x 98 feet and is crescent-shaped with an island-like mound of soil in the center. The report from 1984 indicated the presence of household debris. Artifacts included glass, whiteware, stoneware, crock, and porcelain fragments, a fuse, light bulb base, license plate, tin pot fragments, plastic bottle caps, wooden dowel, a cinder, roofing tile fragments, and two pieces of coal.

A TRADOC site record sheet indicated that the site consists of a dump in a former borrow area. A subsequent survey was performed in 1992. The 1992 report stated that the limits of the site could not be determined, and the collection of artifacts from 1984 supports the interpretation that this site was a recent roadside trash dump, probably removed by the Army between 1984 and 1992. The artifacts collected during the 1984 survey were curated at FBH.

4.24.1.2 Site Reconnaissance

A site reconnaissance was performed to evaluate the current physical condition of the site. The site is located in the northeast portion of FBH within a wooded area. As discussed in the records review section, this site appears to have been used as a roadside trash dump. The household debris observed appeared to be dumped in or along the top edge of two depressions (former borrow areas). Other than the former borrow area and the former dirt road leading to this area (from Lee Road), no unusual surface features were observed. Photographs of this site are presented in Appendix L.

4.24.1.3 Investigation Sampling

The field investigation sampling at EI Site SM25k consisted of the following:

- Collection and analysis of 6 surface soil samples

Samples collected from each site were analyzed for a broad suite of organic and inorganic analytes including VOCs, SVOCs, metals, and landfill parameters. A description of the field investigation sampling activities follows.

Surface Soil Sampling

Six surface soil samples (SM25KSS001 through SM25KSS006) were collected from historic military site EI Site SM25k to assess the potential for soil contamination from the construction debris that was dumped at this site. The surface soil samples were collected from a depth of 0.0 to 0.5 foot bgs. Sample locations are shown in Figure 4.52. Surface soil sampling procedures are discussed in the TSP (HLA, 1993a). Surface soil samples were collected from this site on the basis of the results of the records review and site reconnaissance that indicated the presence of surface debris from past trash dumping. Surface soil samples were collected in areas where surface debris was present.

4.24.2 Results of Investigations

The results of the investigation sampling are presented below.

4.24.2.1 Surface Soil Samples

Table 4.76 presents a summary of the analytical results for analytes detected in the surface soil samples at concentrations greater than IDEM background surface soil concentrations. Figure 4.52 shows the locations at which surface soil samples were collected at this site. Figure 4.53 shows the analytical results that exceed IDEM background concentrations for surface soil samples collected at this site.

Metals

Metals with concentrations that exceeded the IDEM background concentrations were detected in each of the 6 surface soil samples collected at EI Site SM25k. Thirteen metals exceeded IDEM background surface soil concentrations at 1 or more of the surface soil sampling locations at this site. The number of analytes in the 6 surface soil samples that exceeded IDEM background surface soil concentrations ranged from 5 in surface soil Sample SM25KSS003 to 11 in surface soil Sample SM25KSS001. Sodium, thallium and zinc were detected in 6 surface soil samples and were the metals most frequently detected in surface soil samples at concentrations that exceeded background. Arsenic was detected in 5 of 6 samples and was the next most commonly detected analyte. Lead was identified in 4 samples at concentrations below the EPA (1994) action level for residential soils. Metals are naturally occurring elements. Because of the relatively low concentrations of the metals exceeding IDEM background, the concentrations identified in the soil samples may be the result of natural heterogeneity and may not be related to disposal at the site.

Organic Compounds

Organic compounds were detected in each of the 6 surface soil samples collected at this site. The herbicide, 2,4-D, and 5 TICs, including heptacosane, nonacosane, pentacosane, r-sitosterol, and 1-2-epoxycyclohexene, were detected in 1 or more subsurface soil samples at this site at concentrations of less than or equal to 4 mg/kg. The compound bis(2-ethylhexyl)phthalate was identified in 2 surface soil samples but is believed to be a laboratory artifact. The number of compounds in the 6 surface soil samples detected in surface soil samples ranged from 3 compounds

in surface soil Samples SM25KSS005 and SM25KSS006 to 6 and 5 compounds in the surface soil Samples SM25KSS001 and SM25KSS002, respectively. The TICs nonacosane, heptacosane, and r-sitosterol were detected in 6 surface soil sampling locations and were the compounds most frequently detected in surface soil samples (see Table 4.77). The presence of the hydrocarbons heptacosane, nonacosane, and pentacosane in surface soil at this site may be related to vehicle use at the site rather than disposal of POLs. The TIC r-sitosterol is probably associated with onsite vegetation and not related to former site-specific activities. The presence of the herbicide 2,4-D is likely to be associated with past applications of this compound to control the growth of weeds in the general vicinity of this site.

Landfill Parameters

Landfill parameters including ammonia, nitrite/nitrate - TOC, and total recoverable phenolics were detected in each of 6 surface soil samples for EI Site SM25k. Total recoverable phenolics were detected in 2 samples (SM25K003 and SM25K006) at concentrations ranging from 1.57 mg/kg to 2.18 mg/kg. These concentrations of total recoverable phenolics are near the 2.0 mg/kg reporting limit for the total recoverable phenolics analytical method. The detected landfill parameters are common soil constituents and their presence in the surface soil samples collected from this site is likely not related to past site-specific activities.

4.24.3 Conclusions

On the basis of results of the records review, site reconnaissance, and investigation sampling, the following conclusions have been made for EI Site SM25k:

- Information obtained from the records review indicated that this site served as a World War II-era dump. A limited amount of surface debris has been removed from this site.
- The HLA site reconnaissance indicated household debris were dumped at this site.
- Thirteen metals were detected at concentrations that exceeded IDEM background concentrations in each of the 6 surface soil samples collected at this site. Lead was identified in 4 samples at concentrations below the EPA (1994c) action level for residential soil. The relatively low metals concentrations exceeding background concentrations in soil samples may be related to natural heterogeneity.

- Organic compounds including hydrocarbons and the herbicide 2,4-D were detected in each of 6 surface soil samples collected at this site at concentrations of less than or equal to 4 mg/kg. Low concentrations of hydrocarbons may be related to site activities.
- Landfill parameters were detected in each of the surface samples collected at the site, although the detections of the landfill parameters are likely not related to known site-specific activities.

4.24.4 Recommendations

Phase II activities recommended for this site include background evaluation and risk assessment, as described below:

- A risk assessment should be conducted to evaluate risks associated with chemicals of concern at the site.

4.25 EI Site SM25I: Historic Military Site

Historic military site EI Site SM25I was added to the Phase I RFI after field work was completed (Nelson, 1994). The inclusion of the site was prompted by its mention in the draft CERFA Report (Arthur D. Little, Inc. [Little], 1993) as CERFA Parcel with Qualifier 15Q-X(P).

4.25.1 Investigation Activities Performed

The investigation of EI Site SM25I during the Phase I RFI consisted of a limited records review. The CERFA Report (Little, 1993) describes "CERFA Parcels with Qualifiers" as parcels in which there is no evidence of current or past storage, release, or disposal of petroleum products or hazardous materials, but for which there is evidence of the presence of non-CERCLA environmental concerns (Little, 1993). EI Site SM25I is listed as a former grenade course with potential for unexploded ordnance (UXO).

The source for the CERFA listing is a 1946 map of Post Recreational Areas (FBH, 1946). On this map, the grenade course (or grenade court) is near a mental conditioning course and is apparently part of a larger training course. The former grenade course is in the northern portion of the current golf course, as shown in Figure 4.54. The outline of the 3.9-acre course is approximately 280 feet

east-west by 600 feet north-south, and it lies between green No. 5 and green No. 11 on the golf course (FBH, 1946, and Little, 1993).

4.25.2 Conclusions

Based on the site investigation activities conducted for this site, the following conclusion is made:

- On the basis of the limited records review, there is insufficient evidence to assess whether hazardous substances were disposed of at this site.

4.25.3 Recommendations

Because only a limited records review was conducted for this site, the following Phase II activities are recommended:

- Comprehensive records search to include a review of available aerial photography
- Unexploded ordnance (UXO) survey to assess the presence of subsurface UXO
- Surface and subsurface soil sample collection and analysis of soil samples for metals and explosives

4.26 EI Site SM26: Former Sewage Treatment Plant (West of Building 674)

This area is the site of a former sewage treatment plant. A sewage treatment plant appears on historical site maps from 1913 and 1938 at an area south of Shafter Road, west of Building 674, due east of the mobile home park, and northeast of the officer family housing area. However, operations records were not found for this wastewater treatment area. The area is currently being used to dispose of lawn debris (leaves, grass clippings, etc.).

4.26.1 Investigation Activity Performed

The investigation activity performed at the former sewage treatment plant included a geophysical survey. This activity is discussed in the following subsection (see Table 4.78).

4.26.1.1 Geophysical Survey

A surface geophysical survey of the Former Sewage Treatment Plant was conducted using EM profiling, GPR, and M-Scope to delineate the boundaries of the former sewage treatment plant. Parallel geophysical transects were spaced approximately 20 feet apart in both east-west and north-south directions covering the area west of Building 674 (approximately 1.75 acres), where treatment beds may have been located. Denser grid transects were used to further delineate anomalies identified. Figure 4.55 shows the approximate geophysical survey area and survey results. Surface geophysical surveying methods, equipment, and procedures are discussed in Appendix K.

4.26.2 Results of Investigation

Geophysical Survey

The GPR survey successfully located walls between the sewage treatment contact beds (Figure 4.55). The absence of anomalous EM and M-Scope responses at these locations indicates that the walls do not contain reinforcing metal. Neither the former septic tank nor the former sludge bed were detected by any of the 3 methods.

Extensive medium amplitude EM anomalies were observed; these are believed to be caused by clayey fill material. In addition, 5 localized high amplitude EM anomalies indicative of buried metal were also observed. The 5 anomaly locations were confirmed by the GPR and M-Scope surveys (Figure 4.55). GPR profiles show the depth of buried metal to be less than 3 feet bgs.

4.26.3 Conclusions

On the basis of the geophysical survey and site reconnaissance, the following conclusions have been made about EI Site SM26:

- Walls between the sewage treatment contact beds were located. Neither the former septic tank nor former sludge bed were detected using geophysical methods.
- Five high-amplitude EM anomalies indicating buried metal objects within the buried sewage treatment contact beds were observed.

- An area of medium-amplitude EM anomalies was observed that may represent clayey fill material.

4.26.4 Recommendations

Because the general area and some of the specific features of former sewage treatment plant were located by the geophysical survey, soil sampling activities are recommended for the Phase II RFI. However, borings could be more strategically located if a historical map, aerial photograph, or site drawing could be found that would provide information regarding the layout of the former plant. Therefore, the following activities are recommended:

- Collect surface soil samples in the areas of geophysical anomalies or former sewage treatment contact beds, septic tanks, and drying beds if these locations can be assessed. Samples will be collected to assess concentrations of metals and organics in surface soil that may be the result of former site activity. Analyze samples for metals, SVOCs, pesticides, and herbicides.
- Drill soil borings and collect subsurface soil samples in the areas of geophysical anomalies or former sewage contact beds, septic tanks, and drying beds if these locations can be assessed. Samples will be collected to assess concentrations of metals and organics in subsurface soil that may be the result of former site activity. Analyze samples for metals, VOCs, SVOCs, pesticides, and herbicides.
- On the basis of analytical data from soil samples, consider the need for monitoring wells upgradient and downgradient from the site.

4.27 EI Site SM27: Former Sewage Treatment Plant (North of Building 509)

This area is believed to be the former site of a sewage treatment plant. The area is now partially overlain by an oval-shaped running track and exercise field. FBH historical site maps from 1913 and 1938 indicate a former sewage treatment plant north of a site now occupied by Building 509.

4.27.1 Investigation Activity Performed

The investigation activity performed at the former sewage treatment plant included a geophysical survey. Table 4.79 includes a summary of the field investigation activity at this site. This activity is discussed in the following subsections.

Geophysical Survey

A reconnaissance geophysical survey using the M-Scope was performed in the accessible portions of EI Site SM27. In addition, 3 GPR transects were completed parallel to the east side of the running track (Figure 4.56). The objective of the geophysical survey was to delineate the boundaries and residual site substructures of the former sewage treatment plant. Survey control points could not be established at this site because of dense brush. Surface geophysical surveying methods, equipment, and procedures are discussed in Appendix K.

4.27.2 Results of Investigation

Geophysical Survey

The M-Scope survey detected widespread metallic debris within the approximately 150- by 120-foot area shown in Figure 4.56. GPR profiles also imaged 2 localized areas of shallow soil disturbance indicative of possible buried debris south of the larger area.

4.27.3 Conclusions

The geophysical survey performed at the site located an area of possible construction debris that may be remnants of the former structure of the treatment plant and localized disturbances that may indicate remnants of a former structure.

4.27.4 Recommendations

On the basis of Phase I RFI results, the following activities are recommended to investigate the site further:

- Drill up to 5 borings. Drill 1 of these borings to 5 feet bgs at each of the 2 localized areas of shallow soil disturbance. Drill up to 3 of these borings to 5 feet bgs in the area containing widespread metallic debris. Collect one subsurface soil from each boring. Analyze the subsurface soil samples for VOCs, SVOCs, metals, pesticides, and herbicides.

4.28 EI Site SM28: Wash Racks, Grease Racks, Oil/Water Separators

Wash racks, grease racks, and oil/water separators are present at several FBH locations. Wash racks are used to clean utility and personal vehicles, including the engines, on a regular basis, and are

mainly associated with the vehicle maintenance areas. Grease racks are used to lubricate mechanical parts and/or to change oil in vehicles and are also associated mainly with the vehicle maintenance areas. The potential exists that solvents were used in the past at wash racks and grease racks. In general, the drains from wash rack and grease rack areas are equipped with oil/water separators that discharge to the sanitary sewer. Oil/water separators are used to separate any floating product from effluent water from wash racks, grease racks, and other operations before being discharged. Oil/water separators, if not used or maintained properly, can overflow and cause releases of POL to the sanitary sewer, the storm sewer, or to the areas adjacent to the oil/water separator. The oil/water separators associated with several former wash racks reportedly discharged directly to the storm sewer (Weston, 1992).

Sites identified as having wash racks, grease racks, and oil/water separators are listed in Table 6.16 of the Enhanced PA (Weston, 1992).

Several other sites having wash racks, grease racks, and/or oil/water separators not identified in the Weston report were located during the Phase I RFI. A listing of the sites having wash racks, grease racks, and/or oil/water separators listed in the Weston report as wells as the additional sites identified during the EI are summarized in Table 4.80.

The Army has since removed from service all wash racks, grease racks, and oil/water separators that were not connected to POTWs. The Army is planning on taking interim corrective actions at the respective locations that were not connected to the POTW.

4.28.1 Investigation Activity Performed

Records were reviewed to evaluate information related to the discharge of runoff and wastewater from the wash racks, floor drains, grease racks, and oil/water separators at FBH. Information regarding their construction, use, and maintenance was evaluated. Records were reviewed to identify

discharge points and to identify permits associated with those discharges (e.g., information on discharge, construction, and condition. HLA contacted FBH personnel for additional information when the records were incomplete.

4.28.2 Results of Investigation

Table 4.80 provides a summary of the wash racks, grease racks, floor drains, and/or oil/water separators investigated during the EI. Included in Table 4.80 is information regarding the name of the building nearest to the substructure investigated, point of discharge, maintenance, and use. Many of the wash racks, grease racks, floor drains, or oil/water separators have been removed from service.

4.28.3 Conclusions

On the basis of the investigative activity performed and information summarized in Table 4.80 the following conclusions have been made for EI Site SM28:

- Drill soil borings and collect subsurface soil samples in areas adjacent to oil/water separators where leaks or spills are suspected to have occurred.
- Seventeen wash racks, grease racks, oil/water separators, or floor drains discharge to a Publicly Owned Treatment Work (POTW)
- One grease rack discharges to the ground surface
- Three wash racks or floor drains discharge to a storm sewer
- One floor drain and 1 wash rack have no identified discharge connection
- Two wash racks are pumped out

4.28.4 Recommendations

On the basis of the records review, the following activities are recommended for this site:

- Drill soil borings and collect subsurface soil samples in areas adjacent to oil/water separators where leaks or spills are suspected to have occurred.
- For those wash racks, grease racks, and/or oil/water separators that do not discharge to a POTW (i.e., the discharge is to a nearby ditch, stream, or a storm drain), collect 2 sediment samples - 1 upstream and 1 downstream of the outfall.

- Conduct a risk assessment and evaluate risks associated with chemicals of concern at the sites.

4.29 EI Site SM29: Patriotic Site

The Patriotic Site is located southwest of Building 1 in an open field west of Herbert Lord Road. The approximate location of the Patriotic Site is shown in Figure 4.57. The site consists of a relatively small former pit measuring approximately 3 feet wide by 10 feet long. Because of the pit's small dimensions, it is reportedly not greater than 2 feet deep. The former pit was used during the summer of 1992 for a single episode of flag decommissioning by burning. According to site personnel, an unspecified amount of diesel fuel was poured over the flags to be burned in the pit. After the flag-burning ceremony, the pit was backfilled with clean soil.

4.29.1 Investigation Activities Performed

The investigative activities performed at the Patriotic Site included a records review and investigation sampling. Each of these activities is discussed in the following subsections.

4.29.1.1 Records Review

A records search was conducted and Army personnel were interviewed to identify the location of the Patriotic Site and assess whether soil was previously removed and/or if the site was remediated (and if so, by what method). The individual who originally excavated the burn pit in 1992 was located and interviewed. On the basis of this person's information, HLA was able to locate the burn pit. The burn pit was never cleaned out, according to available information.

4.29.1.2 Investigation Sampling

The investigation sampling at the Patriotic Site consisted of the collection and analysis of 2 soil samples from one test pit.

A summary of Phase I sampling locations and rationale for the Patriotic Site is provided in Table 4.81. A more detailed description of the field investigation follows.

Subsurface Soil Sampling

Subsurface soil samples collected from the Patriotic Site were analyzed for VOCs and SVOCs to assess the presence of potential hydrocarbon burn products resulting from past activities at the site. The site was investigated by re-excavating the original burn pit with a backhoe. During excavation, air emissions were monitored using a portable OVA. Two soil samples were collected from the bottom of the original burn pit in areas exhibiting soil discoloration or other indications of contamination. Excavated soil was stored with other field investigation wastes and disposed of according to state and federal regulations. The excavation pit was filled with clean soil.

4.29.2 Results of Investigation

The analytical results of the investigation samples collected from EI Site SM29 are presented in this subsection. The analytical results for analytes that exceed background concentrations are discussed below.

4.29.2.1 Subsurface Soil Samples

Table 4.82 presents a summary of the analytical results for analytes detected in the subsurface soil samples. Figure 4.57 illustrates the locations at which the subsurface soil samples were collected at this site.

Organic Compounds

Organic compound concentrations that exceeded background concentrations were detected in each of the 2 subsurface soil samples collected at this site. Eleven SVOCs including 2-methylnaphthalene and 4-methy phenol and the TICs decane, hendecane, heptacosane, nonacosane, tetradecane, and tridecane (hydrocarbons) were detected. No VOCs were detected in the soil samples. Also detected was 1-ethyl-3-methylbenzene,palmitic acid, and r-sitosterol. Nine of these compounds were detected in subsurface soil collected from SM029TP001 and 6 were detected in the subsurface soil collected from SM029TP002. The analytical results for the compound bis(20ethylhexyl)phthalate and benzoic acid were flagged with a "b" and should not be considered as detections. The presence of the

hydrocarbons and methylnaphthalene and 4-methylphenol in subsurface soil at this site may be related to the use of diesel fuel to ignite flags during decommissioning. However; the presence of r-sitosterol in the subsurface soil samples, a common plant sterol, is the result of vegetation growth.

4.29.3 Conclusions

Test-pit excavation and sampling at the site indicated low concentrations of fuel-related hydrocarbons were present in the near-surface soil.

4.29.4 Recommendations

Phase II activities recommended for this site include a risk assessment as described below:

- Conduct a risk screening for the site following the ASTM (1994) emergency standard for Petroleum Release Sites.
- If the risk screening identifies a health concern, remove and dispose of soil containing fuel-related hydrocarbon compounds.

Table 4.1: Auto Craft Shop, Building 705 (EI Site 1), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objectives
Soil-gas survey	VOCs	Three samples analyzed; samples could not be collected at 19 locations because soil was too impermeable	To assess the potential for VOCs in the subsurface as a result of past activities.
Soil borings and subsurface sampling	VOCs, TPH, and total metals	Five borings drilled to verify soil-gas survey results; locations were revised because soil-gas survey results indicated the presence of contamination; three samples per boring for chemical analysis	To assess the potential for subsurface soil contamination as a result of past activities.
Monitoring well installation and groundwater sampling	VOCs and TPH	Four wells were constructed (one upgradient, three downgradient) because soil-gas survey results indicated the presence of contamination; one round of groundwater sampling	To assess upgradient and downgradient shallow groundwater quality and groundwater flow direction.
Land survey	---	Four monitoring wells	To accurately locate the coordinates and elevation of the new monitoring wells.

--- Not applicable
EI Environmental investigation
TPH Total petroleum hydrocarbons
VOCs Volatile organic compounds

Table 4.2: Summary of Soil-Gas Results for EI Site 1

Sample Identification	Sample Depth (feet)	Compound Detected	Concentration Detected ($\mu g/l$)
E01-13	3	TCA	0.02
E01-16	3.5	TCA	0.006
E01-16	3.5	PCE	0.03
E01-22	3	1,1-DCA	0.4
E01-22	3	TCA	0.002
E01-22	3	TCE	0.006
E01-22	3	Toluene	3
E01-22	3	TVHC	100

Samples are identified in this table and in Figure 4.3 with a prefix of EO1. The Tracer Research Corporation Report identifies these samples as Area EO1, S6-13, S6-16, and S6-22.

1,1-DCA	1,1-Dichloroethane
EI	Environmental investigation
PCE	Tetrachloroethene
TCA	1,1,1,-Trichloroethane
TCE	Trichloroethene
TVHC	Total volatile hydrocarbons
$\mu g/l$	Micrograms per liter

Table 4.3: Summary of Metals Concentrations in Subsurface Soil that are Greater than Background Concentrations: EI Site 1

Site Identification:	EI001SB001	EI001SB001-DUP	EI001SB001	EI001SB001	EI001SB002	EI001SB002	EI001SB002
Depth:	2	2.5	4	7.5	3	5	9
Sample Date:	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93
Analyte (mg/kg)							
Metals							
Arsenic	ND	16 D	ND	ND	11	8.5	ND
Barium	ND	ND	ND	ND	93.8	ND	52.5
Beryllium	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	7.13	5.59	6.86	ND	6.61
Copper	ND	ND	ND	12.6	ND	ND	16
Iron	ND	ND	ND	ND	ND	ND	13,700
Lead	ND	ND	ND	ND	ND	ND	ND
Manganese	ND	ND	ND	ND	389	ND	353
Nickel	ND	ND	ND	16	ND	ND	18.2
Selenium	ND	ND	ND	ND	ND	ND	ND
Sodium	417	419 D	ND	ND	ND	ND	ND
Thallium	34.8	34 D	29.4	30.8	36.6	31.7	37.6
Vanadium	ND	ND	ND	ND	ND	ND	18.2
Zinc	ND	ND	ND	40	ND	ND	43.3

Table 4.3 (Continued)

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	EI001SB003 2 12/15/93	EI001SB003 4 12/15/93	EI001SB003 10 12/15/93	EI001SB004 2 12/21/93	EI001SB004 4 12/21/93	EI001SB004 6 12/21/93
Metals						
Arsenic	ND	7.95	ND	ND	9.9	9.3
Barium	291	231	ND	122	105	ND
Beryllium	ND	0.949	ND	ND	0.962	0.733
Chromium	ND	28.2	10.6	ND	ND	ND
Cobalt	ND	11.8	ND	ND	ND	ND
Copper	ND	ND	13.5	ND	ND	ND
Iron	ND	28,200	12,400	ND	ND	ND
Lead	52.2	17.9	ND	ND	ND	ND
Manganese	692	538	ND	ND	ND	ND
Nickel	ND	32.1	16.9	ND	ND	ND
Selenium	0.413	ND	ND	0.476	ND	ND
Sodium	ND	ND	ND	500	ND	ND
Thallium	25.5	41	36	ND	ND	ND
Vanadium	ND	51.3	15.8	ND	ND	ND
Zinc	ND	76.9	40.5	ND	ND	ND

Table 4.3 (Continued)

Site Identification:	EI001SB005	EI001SB005-DUP	EI001SB005	EI001SB005	EI001SB03A	EI001SB03A	EI001SB03A
Depth:	2.5	3.5	4	6	2	4	9
Sample Date:	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93
Analyte (mg/kg)							
Metals							
Arsenic	ND	13 D	10	6.8	---	---	---
Barium	139	166 D	216	ND	---	---	---
Beryllium	ND	0.879 D	0.889	ND	---	---	---
Chromium	30.3	26.8 D	28	ND	---	---	---
Cobalt	11.6	9.81 D	14	ND	---	---	---
Copper	ND	ND	ND	ND	---	---	---
Iron	30,300	31,800 D	29,200	ND	---	---	---
Lead	ND	ND	16.5	ND	---	---	---
Manganese	ND	548 D	1070	372	---	---	---
Nickel	ND	29.3 D	34.3	ND	---	---	---
Selenium	0.619	0.713 D	ND	ND	---	---	---
Sodium	530	ND	ND	ND	---	---	---
Thallium	34.1	36.9 D	39.4	29.3	---	---	---
Vanadium	ND	45.9 D	ND	ND	---	---	---
Zinc	ND	80.3 D	82.6	ND	---	---	---

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

Background concentrations for analytes in subsurface soil are presented in Section 3.

--- Not analyzed
D Duplicate sample analysis
EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analytes not detected, or not detected at concentrations exceeding background concentration
S Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry method)

Table 4.4: Summary of Analytes Detected in Subsurface Soil: EI Site 1

Site Identification:	EI001SB001	EI001SB001-DUP	EI001SB001	EI001SB001	EI001SB002	EI001SB002	EI001SB002
Depth:	2	2.5	4	7.5	3	5	9
Sample Date:	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93
Analyte (mg/kg)							
VOCs							
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	0.0068 D	0.0079 S	0.008 S	0.01 S	ND	0.0068 S
Acetone	0.014	ND	ND	ND	0.019	ND	ND
TPH							
Diesel fuel	ND	ND	ND	ND	ND	ND	ND

Table 4.4 (Continued)

Site Identification: / Depth: / Sample Date: — Analyte (mg/kg)	EI001SB003 2 12/15/93	EI001SB003 4 12/15/93	EI001SB003 10 12/15/93	EI001SB004 2 12/21/93	EI001SB004 4 12/21/93	EI001SB004 6 12/21/93
VOCs						
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	0.026	0.037	0.023
TPH						
Diesel fuel	ND	ND	ND	ND	14.4	ND

Table 4.4 (Continued)

Site Identification:	EI001SB005	EI001SB005	EI001SB005	EI001SB005-DUP	EI001SB03A	EI001SB03A	EI001SB03A
Depth:	2.5	4	6	3.5	2	4	9
Sample Date:	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93
Analyte (mg/kg)							
VOCs							
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	0.027	ND	0.028 D	0.031	ND	ND
TPH							
Diesel fuel	ND	ND	ND	ND	---	---	---

Background concentrations for analytes in subsurface soil are presented in Section 3.

---	Not analyzed
D	Duplicate sample analysis
EI	Environmental investigation
ND	Analytes not detected, or not detected at concentrations exceeding background concentration
mg/kg	Milligrams per kilogram
S	Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry method)
TPH	Total petroleum hydrocarbons
VOCs	Volatile organic compounds

Table 4.5: Summary of Target Analytes Detected in Groundwater: EI Site 1

Analyte ($\mu g/l$)	Site Identification: Depth: Sample Date:	EI001MW001 8.5 02/02/94	EI001MW001-DUP 8.5 02/02/94	EI001MW002 8.5 02/02/94	EI001MW003 8.5 02/03/94	EI001MW004 8 02/03/94
VOCs						
Chloromethane		ND	ND	ND	ND	2 JP

EI Environmental investigation
JP Analyte concentration is estimated; analyte reported at concentration less than reporting limit; flags applied by laboratory
ND Analyte not detected, or not detected at concentrations exceeding background concentration
$\mu g/l$ Micrograms per liter
VOCs Volatile organic compounds

Table 4.6: Former Post Exchange (PX) Gasoline Station, Building 619 (EI Site 3), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objectives
Soil-gas survey	VOCs	Sixteen samples (including one replicate and one collocated sample) collected around the perimeter of Building 619 and in areas north and east of the building, plus two sampling locations along first 50 feet of sewer lateral from Building 619; samples could not be collected at 12 locations because soil was too impermeable.	To assess the potential for VOCs in the subsurface as a result of past activities.
Soil borings and subsurface sampling	VOCs, TPH, and total metals	Five borings drilled to verify soil-gas survey results; locations were revised because soil-gas survey results indicated the presence of contamination; three soil samples per boring for chemical analysis	To assess the potential for subsurface soil contamination as a result of past activities.
Monitoring well installation and groundwater sampling	VOCs and TPH	Four wells constructed (one upgradient, three downgradient) soil-gas survey results indicated the presence of contamination; four additional borings were drilled because they did not intersect a water-bearing zone. One new well was abandoned after it was damaged. Three additional borings were drilled prior to installation of the replacement well. One round of groundwater sampling	To assess upgradient and downgradient shallow groundwater quality and groundwater flow direction.
Land survey	---	Four monitoring wells	To accurately locate the coordinates and elevation of new monitoring wells.

--- Not applicable
EI Environmental investigation
TPH Total petroleum hydrocarbons
VOCs Volatile organic compounds

Table 4.7: Summary of Soil-Gas Results for EI Site 3

Sample ID	Sample Depth (feet)	Compound Detected	Concentration Detected ($\mu g/l$)
E03-03	4.5	No detections	---
E03-07	6	TCA	0.002
E03-07	6	TVHC	2
E03-08	5.5	TVHC	3
E03-09	5	TCA	0.009
E03-09	5	PCE	0.004
E03-10	5.5	TCA	0.001
E03-12	6	PCE	0.06
E03-13	6	PCE	0.004
E03-13 REP	6	PCE	0.004
E03-15	4.5	No detections	---
E03-16	6	No detections	---
E03-17	4.5	No detections	---
E03-17 COL	5	No detections	---
E03-18	6	No detections	---
E03-20	3.5	TCA	0.003
E03-20	3.5	Toluene	4
E03-20	3.5	Ethylbenzene	3
E03-20	3.5	Xylenes	25
E03-20	3.5	TVHC	120
E03-21	5	No detections	---
E03-51	4.5	No detections	---

Samples are identified in this table and in Figure 4.6 with a prefix of EO3. The Tracer Research Corporation Report identifies these samples as Area EO3, S6-03, S6-07 through S6-10, S6-12, S6-13, S6-15 through S6-18, S6-20, S6-21, and S6-51.

COL	Collocated sample
EI	Environmental investigation
ID	Identification
PCE	Tetrachloroethene
REP	Analyte replicate
TCA	1,1,1,-Trichloroethane
TVHC	Total volatile hydrocarbons
$\mu g/l$	Micrograms per liter

Table 4.8: Summary of Metals Concentrations in Subsurface Soil that are Greater than Background Concentrations: EI Site 3

Site Identification:	EI003SB001	EI003SB001-DUP	EI003SB001	EI003SB001
Depth:	1	5.5	6.5	12.5
Sample Date:	11/30/93	11/30/93	11/30/93	11/30/93
Analyte (mg/kg)				
Metals				
Arsenic	ND	ND	7.5	ND
Barium	ND	105 D	86.8 /L	ND
Beryllium	ND	0.722 D	ND	ND
Cadmium	ND	ND	ND	ND
Chromium	ND	ND	ND	7.07
Cobalt	ND	8.47 D	8.43 /L	4.07
Copper	ND	ND	ND	11.8
Iron	ND	ND	ND	9220
Lead	58.5	54.8 D	88.1 /L	6
Manganese	646	ND	491 /L	354
Nickel	ND	ND	ND	10.7
Selenium	ND	0.448 D	0.579	0.5
Sodium	ND	ND	ND	ND
Thallium	ND	ND	ND	26.8
Vanadium	ND	ND	ND	8.68
Zinc	ND	ND	ND	34.3

Table 4.8 (Continued)

Site Identification:	EI003SB002	EI003SB002	EI003SB002	EI003SB003
Depth:	1	4.5	8	1
Sample Date:	12/01/93	12/01/93	12/01/93	12/01/93
Analyte (mg/kg)				
Metals				
Arsenic	ND	7.2 /I	6.9 /I	ND
Barium	ND	ND	57.7	320
Beryllium	ND	ND	ND	ND
Cadmium	ND	ND	ND	.864
Chromium	ND	ND	13.8 /J	ND
Cobalt	ND	ND	6.23	33.1
Copper	ND	ND	17.3 /JR	ND
Iron	ND	ND	16,100	29,600
Lead	87.5	62.2	34.6	48.5
Manganese	ND	383	ND	4380
Nickel	ND	ND	17.3	ND
Selenium	ND	ND	ND	ND
Sodium	ND	ND	ND	663
Thallium	ND	ND	ND	ND
Vanadium	ND	ND	21.9 /JR	ND
Zinc	ND	ND	63.4	93.5

Table 4.8 (Continued)

Site Identification:	EI003SB003	EI003SB003	EI003SB004	EI003SB004
Depth:	5	9	1	5
Sample Date:	12/01/93	12/01/93	12/01/93	12/01/93
Analyte (mg/kg)				
Metals				
Arsenic	ND	ND	ND	ND
Barium	87.8	ND	ND	ND
Beryllium	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND
Chromium	ND	11.2 /J	ND	ND
Cobalt	7.34	5.76	ND	ND
Copper	ND	15.8 /JR	ND	ND
Iron	ND	13,600	ND	ND
Lead	40.9	6.55	37.8	22.5
Manganese	481	ND	ND	ND
Nickel	ND	18.1	ND	ND
Selenium	ND	ND	ND	ND
Sodium	ND	ND	ND	ND
Thallium	ND	ND	ND	ND
Vanadium	ND	16.9 /JR	ND	ND
Zinc	ND	46.3	ND	ND

Table 4.8 (Continued)

Site Identification:	EI003SB004	EI003SB005	EI003SB005	EIs003B005
Soil Association:	11	1.5	5	9.5
Sample Date:	12/01/93	11/20/93	11/20/93	11/20/93
Analyte (mg/kg)				
Metals				
Arsenic	ND	22	7	ND
Barium	ND	ND	ND	57.4
Beryllium	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND
Chromium	11.4 /J	ND	ND	10.8
Cobalt	5.37	ND	ND	5.85
Copper	14.8 /IR	ND	ND	14.6
Iron	13,700	ND	ND	12,400
Lead	7.08	ND	35.9	6.3
Manganese	320	ND	ND	ND
Nickel	19.4	ND	ND	16.9
Selenium	ND	0.5	0.301	ND
Sodium	ND	ND	ND	ND
Thallium	14.8	23.9	27.8	28.1
Vanadium	14.8 /JR	ND	ND	18
Zinc	44.5	ND	ND	43.9

Analytical results for calcium, magnesium, potassium, and aluminum are included in the data summary, Appendix C.

D	Duplicate sample analysis
EI	Environmental investigation
/I	The low spike recovery is high; qualifier applied during Army data review
J	Value is estimated
/J	The low spike recovery is low; qualifier applied during Army data review
/L	Missed holding time for sample analysis; qualifier applied during Army data review
mg/kg	Milligrams per kilogram
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
P	Value is less than reporting limit but greater than instrument detection limit
/R	Value is unacceptable; qualifier applied during Army data review

Table 4.9: Summary of Analytes Detected in Subsurface Soil: EI Site 3

Site Identification: Depth: Sample Date: Analyte (mg/kg)	EI003SB001 1 11/30/93	EI003SB001-DUP 5.5 11/30/93	EI003SB001 6.5 11/30/93	EI003SB001 12.5 11/30/93
VOCs				
1,2,4-Trimethylcyclohexane	ND	ND	ND	ND
1-Ethyl-2-methylbenzene	ND	ND	ND	ND
2-Methylheptane	ND	ND	ND	ND
3-Methyloctane	ND	ND	ND	ND
Acetone	ND	ND	ND	ND
Benzene	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND
Ethylcyclohexane	ND	ND	ND	ND
Heptane	ND	ND	ND	ND
Octane	ND	ND	ND	ND
Toluene	ND	ND	ND	ND
Xylenes, total combined	ND	ND	ND	ND
TPH				
Diesel fuel	ND	121 D	ND	ND
Gasoline	ND	33.6 D	ND	ND

Table 4.9 (Continued)

Site Identification:	EI003SB002	EI003SB002	EI003SB002	EI003SB003
Depth:	1	4.5	8	1
Sample Date:	12/01/93	12/01/93	12/01/93	12/01/93
Analyte (mg/kg)				
VOCs				
1,2,4-Trimethylcyclohexane	ND	ND	ND	ND
1-Ethyl-2-methylbenzene	ND	ND	ND	ND
2-Methylheptane	ND	ND	ND	ND
3-Methyloctane	ND	ND	ND	ND
Acetone	ND	ND	ND	ND
Benzene	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND
Ethylcyclohexane	ND	ND	ND	ND
Heptane	ND	ND	ND	ND
Octane	ND	ND	ND	ND
Toluene	ND	ND	ND	ND
Xylenes, total combined	ND	ND	ND	ND
TPH				
Diesel fuel	ND	ND	ND	ND
Gasoline	ND	ND	ND	ND

Table 4.9 (Continued)

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	EI003SB003 5 12/01/93	EI003SB003 9 12/01/93	EI003SB004 1 12/01/93	EI003SB004 5 12/01/93
VOCs				
1,2,4-Trimethylcyclohexane	ND	1 S	ND	ND
1-Ethyl-2-methylbenzene	ND	1 S	ND	ND
2-Methylheptane	ND	0.6 S	ND	ND
3-Methyloctane	ND	1 S	ND	ND
Acetone	ND	ND	ND	ND
Benzene	ND	0.06 JP	ND	ND
Bromodichloromethane	ND	0.1	ND	ND
Ethylcyclohexane	ND	1 S	ND	ND
Heptane	ND	0.6 S	ND	ND
Octane	ND	2 S	ND	ND
Toluene	ND	0.2	ND	ND
Xylenes, total combined	ND	1	ND	ND
TPH				
Diesel fuel	ND	21 /L	ND	ND
Gasoline	ND	34.1 /L	ND	ND

Table 4.9 (Continued)

Site Identification: / Soil Association: / Sample Date: / Analyte (mg/kg)	EI003SB004 11 12/01/93	EI003SB005 1.5 11/20/93	EI003SB005 5 11/20/93	EI003SB005 9.5 11/20/93
VOCs				
1,2,4-Trimethylcyclohexane	ND	ND	ND	ND
1-Ethyl-2-methylbenzene	ND	ND	ND	ND
2-Methylheptane	ND	ND	ND	ND
3-Methyloctane	ND	ND	ND	ND
Acetone	ND	ND	0.014	ND
Benzene	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND
Ethylcyclohexane	ND	ND	ND	ND
Heptane	ND	ND	ND	ND
Octane	ND	ND	ND	ND
Toluene	ND	ND	ND	ND
Xylenes, total combined	ND	ND	ND	ND
TPH				
Diesel fuel	ND	ND	79.6	ND
Gasoline	ND	ND	ND	ND

D Duplicate sample analysis
EI Environmental investigation
/I The low spike recovery is high; qualifier applied during Army data review
/J The low spike recovery is low; qualifier applied during Army data review
J Value is estimated
/L Missed holding time for sample analysis; qualifier applied during Army data review
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
P Value is less than reporting limit but greater than instrument detection limit
TPH Total petroleum hydrocarbons
VOCs Volatile organic compounds

Table 4.10: Summary of Target Analytes Detected in Groundwater: EI Site 3

Site Identification:	EI003MW001	EI003MW002	EI003MW003	EI003MW004
Depth:	9.5	6.4	9	16
Sample Date:	02/16/94	02/16/94	02/16/94	02/16/94
Analyte (μg/l)				
VOCs				
Chloroform	ND	4.3	ND	ND

μg/l Micrograms per liter
EI Environmental investigation
ND Analyte not detected, or not detected at concentration exceeding background cncentrations
VOCs Volatile organic compounds

Table 4.11: Directorate of Installation Support (DIS) Engineering/Maintenance, Building 26 (EI Site 4), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objectives
Soil-gas survey	VOCs	Ninteen samples around Building 26; Samples could not be collected at 20 locations because soil was too impermeable	To assess the potential for VOCs in the subsurface as a result of past activities.
PCB screening	PCBs	Twenty-eight samples spaced at approximately 25- to 50-foot intervals in an area north of Building 26; three verification samples were collected adjacent to three screening sample locations for laboratory analysis	To assess the potential for PCB contamination in site surface soil as a result of past activities.
Soil borings and subsurface sampling	VOCs, SVOCs, TPH, and total metals	Five borings drilled to verify soil-gas survey results; locations were revised because soil-gas survey results indicated the presence of contamination; three samples per boring for chemical analysis	To assess vertical extent of possible metals and organic contaminants in the subsurface as a result of past activities.
Monitoring well installation and groundwater sampling	VOCs, SVOCs, TPH, and total and dissolved metals	Four wells constructed (one upgradient, three downgradient) because soil-gas survey results indicated the presence of contamination; one round of groundwater sampling	To assess upgradient and downgradient shallow groundwater quality and groundwater flow direction.
Land survey	---	Four monitoring wells	To accurately locate the coordinates and elevations of new monitoring wells.

--- Not applicable
EI Environmental investigation
PCB Polychlorinated biphenyl
SVOCs Semivolatile organic compounds
TPH Total petroleum hydrocarbons
VOCs Volatile organic compounds

Table 4.12: Summary of Soil-Gas Results for EI Site 4

Sample ID	Sample Depth (feet)	Compound Detected	Concentration Detected (μg/l)
E04-02	3	TCE	0.3
E04-02	3	PCE	2
E04-02	3	TVHC	2*
E04-03	3.5	PCE	4
E04-03	3.5	TVHC	1*
E04-05	6	CHCL3	0.004
E04-05	6	TCA	0.007
E04-05	6	TCE	0.02
E04-05	6	PCE	0.3
E04-07	5	TCA	0.003
E04-07	5	PCE	13
E04-07	5	TVHC	6*
E04-09	6	CHCL3	0.002
E04-09	6	TCA	0.002
E04-09	6	TCE	0.008
E04-09	6	PCE	0.006
E04-10	5	TCA	0.06
E04-10 REP	5	TCA	0.06
E04-14	4	Vinyl chloride	7
E04-14	4	Toluene	150
E04-14	4	Ethylbenzene	140
E04-14	4	Xylenes	310
E04-14	4	TVHC	4700
E04-15	3	PCE	0.01
E04-15	3	Vinyl chloride	5
E04-15	3	Toluene	2
E04-15	3	Ethylbenzene	2
E04-15	3	Xylenes	5
E04-15	3	TVHC	31
E04-16	5.5	TCA	0.007
E04-16	5.5	PCE	0.04
E04-17	3	PCE	0.02
E04-17 REP	3	PCE	0.03
E04-19	5	CHCL3	0.008
E04-19	5	TCA	0.1
E04-19	5	TCE	12
E04-19	5	PCE	4
E04-19	5	TVHC	6*
E04-20	3	TCA	0.005
E04-20	3	PCE	0.05
E04-26	3	TCA	0.001
E04-26	3	TCE	0.008
E04-26	3	PCE	0.004
E04-30	3	PCE	0.01
E04-31	4	PCE	0.4

Table 4.12 (Continued)

Sample ID	Sample Depth (feet)	Compound Detected	Concentration Detected ($\mu g/l$)
E04-32	4	1,2-DCE (total)	0.3
E04-32	4	CHCL3	0.03
E04-32	4	TCA	0.005
E04-32	4	TCE	34
E04-32	4	PCE	6
E04-32	4	TVHC	16*
E04-32 COL	3	TCE	91
E04-32 COL	3	PCE	8
E04-32 COL	3	TVHC	42*
E04-01A	6	TCA	0.001
E04-01A	6	TCE	0.006
E04-01A	6	PCE	3
E04-01A	6	TVHC	2*
E04-02A	5.5	TCE	0.006
E04-02A	5.5	PCE	0.1
E04-02A	5.5	TVHC	2
E04-05A	3.5	CHCL3	0.01
E04-05A	3.5	TCA	0.004
E04-05A	3.5	TCE	0.08
E04-05A	3.5	PCE	0.004

Samples are presented in this table and in Figure 4.2 with a prefix of E04. The Tracer Research Corporation Report lists the prefix as E26.

CHCL3	Chloroform
COL	Collocated sample
EI	Environmental investigation
ID	Identification
PCE	Tetrachloroethene
REP	Replicate sample
TCA	1,1,1,-Trichloroethane
TCE	Trichloroethene
TVHC	Total volatile hydrocarbons
$\mu g/l$	Micrograms per liter
1,2-DCE (total)	Total 1,2-dichloroethene

* TVHC concentrations include halocarbons.

Table 4.13: Summary of Analytes Detected in Surface Soil: EI Site 4

Site Identification:	EI004PCB11	EI004PCB19	EI004PCB26
Soil Association:	C-B	C-B	C-B
Sample Date:	11/19/93	11/19/93	11/19/93
Analyte (mg/kg)			
Pesticides/PCBs			
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	ND	ND	0.0712 C
2,2-bis (p-Chlorophenyl)-1,1-dichloroethane(DDD)	ND	ND	0.0776 C
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene(DDE)	ND	ND	0.0598 C
Aldrin	ND	ND	0.0117 C
alpha-Chlordane	ND	ND	0.0916 C
Dieldrin	ND	ND	0.0802 C
gamma-Chlordane	ND	ND	0.098 C
Heptachlor epoxide	ND	ND	0.00445 C
PCB 1260	ND	ND	0.0763 C

C Analysis was confirmed
C-B Crosby-Brookston soil association
EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
PCBs Polychlorinated biphenyl

Table 4.14: Summary of Metals Concentrations in Subsurface Soil that are Greater than Background Concentrations: EI Site 4

Site Identification:	EI004SB001	EI004SB001	EI004SB001	EI004SB002	EI004SB002-DUP	EI004SB002
Depth:	3	5	7	1	12.5	5
Sample Date:	12/16/93	12/16/93	12/16/93	12/18/93	12/18/93	12/18/93
Analyte (mg/kg)						
Metals						
Arsenic	ND	ND	ND	ND	ND	11.2
Barium	ND	ND	ND	ND	ND	80.2
Beryllium	ND	ND	ND	ND	0.714 D	ND
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND
Cobalt	6.87	6.86	ND	ND	ND	8.78
Copper	ND	ND	14.7	ND	ND	ND
Cyanide	ND	ND	ND	0.355	ND	ND
Iron	ND	ND	13,600	ND	ND	ND
Lead	ND	ND	ND	88.5	ND	ND
Manganese	ND	377	ND	ND	ND	649
Mercury	ND	ND	ND	0.233	ND	ND
Nickel	ND	ND	17	ND	ND	31.8
Selenium	ND	ND	ND	0.477	ND	ND
Sodium	ND	ND	ND	559	ND	ND
Thallium	38.9	37.7	33.9	34.9	ND	45.8
Vanadium	ND	ND	13.6	ND	ND	ND
Zinc	ND	ND	ND	93.1	ND	ND

Table 4.14 (Continued)

Analyte (mg/kg) — Site Identification: / Depth: / Sample Date:	EI004SB003 3 12/17/93	EI004SB003 5.5 12/17/93	EI004SB003 6 12/17/93	EI004SB004 3.3 12/17/93	EI004SB004 5.5 12/17/93	EI004SB004 20 11/30/93
Metals						
Arsenic	ND	ND	ND	10	7.44	4.62
Barium	166	ND	ND	114	ND	ND
Beryllium	1.03	ND	ND	0.664	ND	ND
Cadmium	0.913	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND
Cobalt	10.3	ND	9.06	17.9	ND	ND
Copper	28.5	ND	ND	28.1	ND	ND
Cyanide	ND	ND	ND	ND	ND	ND
Iron	24,900	ND	ND	28,100	ND	ND
Lead	ND	ND	ND	15.3	ND	ND
Manganese	866	468	ND	460	552	730
Mercury	ND	ND	ND	ND	ND	ND
Nickel	72.4	ND	ND	26.8	ND	ND
Selenium	ND	ND	ND	ND	ND	ND
Sodium	ND	ND	ND	ND	ND	ND
Thallium	29.7	43.3	38.3	35.8	34.8	29
Vanadium	ND	ND	ND	ND	ND	ND
Zinc	107	ND	ND	80.5	ND	ND

Table 4.14 (Continued)

Analyte (mg/kg) / Site Identification:	EI004SB005	EI004SB005-DUP	EI004SB005	EI004SB005
Depth:	1.5	5.8	6	12
Sample Date:	12/18/93	12/18/93	12/18/93	12/18/93
Metals				
Arsenic	ND	ND	ND	ND
Barium	ND	91.6 D	108	45.8
Beryllium	ND	0.862 D	1.18	ND
Cadmium	ND	ND	ND	ND
Chromium	ND	ND	ND	11.4
Cobalt	ND	ND	8.53	5.84
Copper	ND	ND	ND	11.4
Cyanide	ND	ND	ND	ND
Iron	ND	ND	23,800	11,200
Lead	ND	ND	16.3	5.84
Manganese	ND	ND	389	297
Mercury	ND	ND	ND	ND
Nickel	ND	ND	26.3	14.9
Selenium	ND	ND	ND	ND
Sodium	435	ND	ND	ND
Thallium	ND	ND	ND	ND
Vanadium	ND	ND	46.4	17.2
Zinc	ND	ND	85.3	34.3

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D Duplicate sample analysis
EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.15: Summary of Analytes Detected in Subsurface Soil: EI Site 4

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	EI004SB001 3 12/16/93	EI004SB001 5 12/16/93	EI004SB001 7 12/16/93	EI004SB002 1 12/18/93	EI004SB002 5 12/18/93	EI004SB002-DUP 12.5 12/18/93	EI004SB002 17.5 12/18/93
VOCs							
1,1,2-Trichlor-1,2,2-trifluoroethane	ND	ND	ND	ND	ND	0.0067 DS	ND
Acetone	0.016	0.014	ND	ND	ND	0.037 D	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	0.083	ND	0.023 D	1
SVOCs							
bis (2-Ethylhexyl) phthalate	ND	ND	ND	ND	ND	ND	ND
Di-N-butyl phthalate	0.23	0.86	ND	ND	0.53	0.27 D	0.61
Tetradecane	ND	ND	ND	ND	ND	ND	0.34 S
THP							
Diesel fuel	ND	ND	ND	82.5	ND	ND	ND
Gasoline	ND	ND	ND	63.1	ND	ND	ND

Table 4.15 (Continued)

Site Identification:	EI004SB003	EI004SB003	EI004SB003	EI004SB004	EI004SB004	EI004SB004
Depth:	3	5.5	6	3.3	5.5	20
Sample Date:	12/17/93	12/17/93	12/17/93	12/17/93	12/17/93	11/30/93
Analyte (mg/kg)						
VOCs						
1,1,2-Trichlor-1,2,2-trifluoroethane	ND	ND	ND	0.0077 S	ND	ND
Acetone	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	0.017	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND
SVOCs						
bis (2-Ethylhexyl) phthalate	ND	ND	ND	ND	ND	0.79
Di-N-butyl phthalate	0.26	ND	0.2 /?	ND	ND	ND
Tetradecane	ND	ND	ND	ND	ND	ND
TPH						
Diesel fuel	ND	ND	ND	ND	ND	ND
Gasoline	ND	ND	ND	ND	ND	ND

Table 4.15 (Continued)

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	EI004SB005 1.5 12/18/93	EI004SB005-DUP 5.8 12/18/93	EI004SB005 6 12/18/93	EI004SB005 12 12/18/93
VOCs				
1,1,2-Trichlor-1,2,2-trifluoroethane				
Acetone	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND
SVOCs				
bis (2-Ethylhexyl) phthalate	ND	ND	ND	ND
Di-N-butyl phthalate	0.26	0.2 /? D	ND	0.26
Tetradecane				
TPH				
Diesel fuel	ND	ND	ND	ND
Gasoline	ND	ND	ND	ND

/? Control chart either not received or not yet approved by the Army; qualifier applied during Army data review
D Duplicate sample analysis
EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
S Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry)
SVOCs Semivolatile organic compounds
TPH Total petroleum hydrocarbons
VOCs Volatile organic compounds

Table 4.16: Summary of Metals Concentrations in Groundwater that are Greater than Background Concentrations: EI Site 4

Site Identification:	EI004MW001	EI004MW001-DUP	EI004MW002	EI004MW003	EI004MW004
Depth:	19.5	19.5	21.2	19.5	17.5
Sample Date:	02/04/94	02/04/94	02/06/94	02/05/94	02/05/94
Analyte ($\mu g/l$)					
Metals					
Antimony (filtered)	ND	ND	ND	3.9 F	3.3 F
Arsenic	23.3	23 D	8.4	32.7	18.5
Arsenic (filtered)	15.5 F	ND	5 F	ND	16 F
Barium	211	166 D	ND	184	ND
Barium (filtered)	130 F	122 DF	ND	ND	ND
Chromium	31.2	24.2 D	12.3	44	ND
Copper	16.8	16.5 D	7.85	45.2	ND
Iron	14,700	12,500 D	8120	38,600	ND
Iron (filtered)	370 F	411 DF	1130 F	ND	341 F
Lead	6.1	7.3 D	2.6	20.4	ND
Manganese	383 B	371 DB	373	795 B	ND
Manganese (filtered)	ND	ND	237 F	ND	195 FB
Nickel	21.1	22.9 D	ND	43.2	ND
Sodium	26,600	25,000 D	39,600 /I	62,600	70,200
Sodium (filtered)	26,100 F	24,400 DF	38,400 F/I	61,100 F	66,400 F
Vanadium	26.7	10.5 D	ND	41.4	ND
Zinc	44.2	42.3 D	ND	145	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

B	Analyte detected in associated method blank; flag applied by laboratory
D	Duplicate sample analysis
EI	Environmental investigation
F	Filtered
/I	The low-spike recovery is high; qualifier applied during Army data review
$\mu g/l$	Micrograms per liter
ND	Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.17: Summary of Analytes Detected in Groundwater: EI Site 4

Site Identification: / Depth: / Sample Date: / Analyte (μg/l)	EI004MW001 19.5 02/04/94	EI004MW001-DUP 19.5 02/04/94	EI004MW002 21.2 02/06/94	EI004MW003 19.5 02/05/94	EI004MW004 17.5 02/05/94
VOCs					
Chloromethane	ND	3.1 D	ND	ND	ND
SVOCs					
bis(2-Ethylhexyl) phthalate	ND	ND	2.4 B	2.9 B	2.8 B
Cyclohexanol	ND	ND	ND	ND	20 S

B — Analyte detected in associated method blank; flag applied by laboratory
D — Duplicate sample analysis
EI — Environmental investigation
μg/l — Micrograms per liter
ND — Analyte not detected or not detected at concentration exceeding background concentrations
SVOCs — Semivolatile organic compounds
VOCs — Volatile organic compounds

Table 4.18: Comparison Between Upgradient and Downgradient Wells: EI Site 4

Analytes	Upgradient Well	Downgradient Wells			
	EI004MW001 (Average Conc)	EI004MW002	EI004MW003	EI004MW004	Average
Total Metals					
Arsenic	23.15	8.40	32.70	18.50	19.87
Barium	188.50	75.20	184.00	50.20	103.13
Chromium	27.70	12.30	44.00	ND	19.60
Copper	16.65	7.85	45.20	ND	18.52*
Iron	13,600.00	8120.00	38,600.00	2550.00	16,423.33*
Lead	6.70	2.60	20.40	ND	8.00*
Manganese	377.00 B	373.00	795.00 B	29.00 B	475.67*
Nickel	22.00	ND	43.20	ND	19.40
Sodium	25,800.00	39,600.00 /I	62,600.00	70,200.00	57,466.67*
Vanadium	18.60	ND	41.40	ND	17.13
Zinc	43.25	26.00	145.00	ND	60.33*
Dissolved Metals					
Antimony	ND	ND	3.90 F	3.30 F	2.9*
Arsenic	9 F	5.00 F	ND	16.00 F	7.42
Barium	126.00 F	46.60 F	75.60 F	39.00 F	53.73
Iron	390.50 F	1130.00 F	ND	341.00 F	558.42*
Manganese	143.00 FB	237.00 F	78.10 FB	195.00 FB	170.03*
Sodium	25,250.00 F	38,400.00 F/I	61,100.00 F	66,400.00 F	55,300.00*
Organic Analytes					
Bis (2-ethylhexyl) phthalate	ND	2.40 B	2.90 B	2.80 B	2.70*
Chloromethane	2.55	ND	ND	ND	1.00
Cyclohexanol	ND	ND	ND	20.00	20.00

Analytical results for calcium, magnesium, potassium, and aluminum are included in the data summary.
Values shown in bold exceed applicable target restoration goals.

B Analyte detected in associated method blank; flag applied by laboratory Appendix C
EI Environmental investigation
F Filtered
/I Low-spike recovery if high; qualifier applied during Army data review
ND Not detected

* Value increases in downstream samples as compared to upstream samples

Table 4.19: Electrical Shop, Building 4 (EI Site 5), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objectives
PCB screening	PCBs	Twenty-one samples located at approximately 25- to 45-foot intervals east and south of Building 4; three verification samples were collected adjacent to three screening sample locations for laboratory analysis	To assess the potential for PCB contamination in site surface soil as a result of past activities.
Surface soil sampling	TPH	Five surface soil samples located south of Building 4, near former diesel generators	To assess the potential for diesel- and POL-impacted surface soil as a result of past activities.
Soil boring and subsurface soil sampling	TPH and PCBs	Three borings drilled in area east of Building 4; two borings drilled in area south of Building 4, near former diesel generators; locations were revised on the basis of PCB screening results and field conditions; three samples per boring for chemical analysis	To assess the potential for PCBs and POL in the subsurface as a result of past activities.

EI Environmental investigation
PCB Polychlorinated biphenyl
POL Petroleum, oils, and lubricants
TPH Total petroleum hydrocarbons
VOCs Volatile organic compounds

Table 4.20: Summary of Analytes Detected in Surface Soil: EI Site 5

Site Identification:	EI005PCB10	EI005PCB13	EI005SS001	EI005SS002	EI005SS003	EI005SS004	EI005SS005
Soil Association:	C-B	C-B	C-B	C-B	C-B	C-B	C-B
Sample Date:	11/18/93	11/18/93	11/29/93	11/29/93	11/29/93	11/29/93	11/29/93
Analyte (mg/kg)							
Pesticides/PCBs							
delta-Benzenehexachloride	ND	0.0143 C	ND	ND	ND	ND	ND
gamma-Chlordane	0.00601 C	ND	ND	ND	ND	ND	ND
PCB 1260	0.59 C	ND	ND	ND	ND	ND	ND

C Analysis was confirmed
C-B Crosby-Brookston soil association
EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
PCBs Polychlorinated biphenyls

Table 4.21: Summary of Analytes Detected in Subsurface Soil: EI Site 5

Analyte (mg/kg) — Site Identification:	EI005SB001	EI005SB001	EI005SB001	EI005SB002	EI005SB002	EI005SB002	EI005SB003	EI005SB003
Depth:	2	4	9.5	2.5	4.5	9.5	2	4
Sample Date:	01/03/94	01/03/94	01/03/94	01/03/94	01/03/94	01/03/94	01/04/94	01/04/94
Pesticides								
2,2-bis-(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	ND	ND	ND	0.0185 C	ND	ND	ND	ND
2,2-bis-(p-Chlorophenyl)-1,1-dichloroethane (DDD)	ND	ND	ND	0.01 C	ND	ND	ND	ND
TPH								
Diesel fuel	ND	ND	ND	ND	ND	ND	20.0	520.0

Table 4.21 (Continued)

Analyte (mg/kg) — Site Identification: / Depth: / Sample Date:	EI005SB003 7.5 01/04/94	EI005SB004 2.5 01/04/94	EI005SB004 4.5 01/04/94	EI005SB004-DUP 5 01/04/94	EI004SB005 2.5 01/04/94	EI005SB005 4 01/04/94	EI005SB005-DUP 4.5 01/04/94	EI005SB005 7.5 01/04/94
Pesticides								
2,2-bis-(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	ND	ND	ND	ND	ND	ND	ND	ND
2,2-bis-(p-Chlorophenyl)-1,1-dichloroethane (DDD)	ND	ND	ND	ND	ND	ND	ND	ND
TPH								
Diesel fuel	ND	ND	ND	ND	ND	ND	ND	ND

C Analysis was confirmed
EI Environmental investigation
ND Analyte not detected, or not detected at concentration exceeding background concentrations
mg/kg Millgrams per kilogram
TPH Total petroleum hydrocarbons

Table 4.22: Former Coal Storage Yard, Building 2 (EI Site 6), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objectives
Surface soil sampling	Total metals and pH	Seven surface soil samples collected around perimeter of concrete coal storage pad; an additional three samples located east of the concrete pad	To assess the potential for metals in surface soil as a result of past activities.
Soil boring and subsurface sampling	Total metals and pH	Seven soil borings drilled/sampled to 3 feet bgs at the same locations as the surface soil samples located around perimeter of concrete coal storage pad; an additional three borings located east of the concrete pad; one sample per boring collected from approximately 2 to 3 feet bgs for chemical analysis	To assess the potential for metals in the subsurface soil as a result of past activities.

bgs Below ground surface
EI Environmental investigation

Table 4.23: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations and Soil pH: EI Site 6

Site ID:	EI006SS001	EI006SS002	EI006SS003	EI006SS004	EI006SS005	EI006SS005-DUP
Soil Association:	C-B	C-B	C-B	C-B	C-B	C-B
Sample Date:	11/29/93	11/29/93	11/29/93	11/29/93	11/29/93	11/29/93
Analyte (mg/kg)						
Metals						
Arsenic	9.7	7.3	7.1	7.4	7	ND
Barium	ND	ND	ND	106	ND	ND
Beryllium	ND	ND	ND	ND	ND	ND
Cadmium	1.33	ND	ND	1.72	ND	0.587 D
Chromium	24.2	ND	ND	25.9	ND	ND
Cobalt	ND	ND	ND	7.64	ND	ND
Copper	36.4	21.9	ND	48	ND	ND
Iron	ND	ND	ND	ND	ND	ND
Lead	44.8	ND	ND	61.6	57	311 D
Manganese	352	ND	464	616	349	ND
Mercury	0.737	0.215	ND	0.421	ND	ND
Nickel	ND	ND	ND	19.7	ND	ND
Selenium	0.57	0.595	0.56	0.85	ND	ND
Silver	ND	ND	ND	0.887	ND	ND
Sodium	388	ND	ND	ND	419	ND
Thallium	26.7	19.4	26.2	13.5	26.8	27.6 D
Zinc	110	87.5	ND	123	86.1	93.2 D
pH	7.96	7.88	7.82	8.06	7.94	7.72

Table 4.23 (Continued)

Site ID:	EI006SS006	EI006SS007	EI006SS008	EI006SS009	EI006SS010
Soil Association:	C-B	C-B	C-B	C-B	C-B
Sample Date:	11/29/93	11/30/93	11/30/93	11/30/93	11/30/93
Analyte (mg/kg)					
Metals					
Arsenic	ND	9.6	ND	ND	ND
Barium	ND	117	ND	ND	ND
Beryllium	ND	0.884	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND
Cobalt	ND	10.8	ND	ND	ND
Copper	ND	22.7	ND	25.4	23
Iron	ND	20,300	ND	ND	ND
Lead	ND	ND	ND	39.9	35.3
Manganese	ND	848	ND	417	369
Mercury	ND	ND	ND	ND	ND
Nickel	ND	23.9	ND	ND	ND
Selenium	ND	0.5	0.5	1.09	0.86
Silver	ND	ND	ND	ND	ND
Sodium	ND	526	ND	435	430
Thallium	16.8	ND	20.2	ND	ND
Zinc	ND	83.6	ND	83.3	82.9
pH	8.24	7.73	7.52	7.33	7.38

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

C-B Crosby-Brookston soil association
D Duplicate sample analysis
EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.24: Summary of Metals and Cyanide Concentrations in Subsurface Soil that are Greater than Background Concentrations and Soil pH: EI Site 6

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	EI006SB001 2.5 12/20/93	EI006SB002 1 12/21/93	EI006SB003 2.5 12/20/93	EI006SB004 2.5 12/21/93	EI006SB005 2.5 12/21/93
Metals					
Arsenic	ND	ND	35	ND	ND
Beryllium	1.15	ND	ND	1.14	ND
Cyanide	ND	ND	ND	ND	1.75
Selenium	ND	ND	0.392	0.604	ND
Sodium	773	429	ND	433	ND
pH	7.7	7.6	7.5	7.5	7

Table 4.24 (Continued)

Analyte (mg/kg) — Site Identification: / Depth: / Sample Date:	EI006SB006 / 2 / 12/21/93	EI006SB006-DUP / 2.3 / 12/21/93	EI006SB007 / 2.5 / 12/21/93	EI006SB008 / 2 / 12/21/93	EI006SB009 / 2.3 / 12/21/93	EI006SB010 / 1 / 12/21/93
Metals						
Arsenic	ND	ND	ND	ND	ND	ND
Beryllium	1.53	ND	ND	ND	ND	ND
Cyanide	ND	ND	ND	ND	ND	ND
Selenium	0.354	ND	0.353	0.54	ND	ND
Sodium	436	ND	672	494	ND	ND
pH	7.5	5.0	7.1	7.4	7.6	7.6

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.25: Summary of Analytes Detected in Subsurface Soil: EI Site 6

Site Identification:	EI006SB001	EI006SB002	EI006SB003	EI006SB004	EI006SB005
Depth:	2.5	1	2.5	2.5	2.5
Sample Date:	12/20/93	12/21/93	12/20/93	12/21/93	12/21/93
Analyte (mg/kg)					
Landfill Parameters					
pH	7.7	7.6	7.5	7.5	7
Ammonia	ND	ND	ND	ND	ND
Nitrite, nitrate - nonspecific	ND	ND	ND	ND	ND
Total organic carbon	ND	ND	ND	ND	ND

Table 4.25 (Continued)

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	EI006SB006 2 12/21/93	EI006SB006-DUP 2.3 12/21/93	EI006SB007 2.5 12/21/93	EI006SB008 2 12/21/93	EI006SB009 2.3 12/21/93	EI006SB010 1 12/21/93
Landfill Parameters						
pH	7.5	8	7.1	7.4	7.6	7.6
Ammonia	ND	ND	ND	ND	ND	ND
Nitrite, nitrate - nonspecific	ND	ND	ND	ND	ND	ND
Total organic carbon	ND	ND	ND	ND	ND	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
mg/kg Milligram per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.26: Pesticide Mixing and Storage Areas - DIS Maintenance Storage Shed, Building 27 (EI Site SM18), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Surface-water sampling	Pesticides, herbicides, and total and dissolved metals	Two surface-water samples collected from the basement of Building 27	To assess aqueous concentrations of pesticides, herbicides, and metals in water accumulating in the former basement pesticide storage.
Sediment sampling	Pesticides, herbicides, and total metals	Three sediment samples collected from the basement floor of Building 27	To assess the potential for pesticides, herbicides, and metals in sediment remaining in this former pesticide storage location.

DIS Directorate of Installation Support
EI Environmental investigation

Table 4.27: Summary of Target Analyte Concentrations Greater than Method Reporting Limits in Surface-Water Samples Collected at EI Site SM18

Analyte (µg/l) — Site Identification: / Sample Date:	SM018SW001 01/11/94	SM018SW002 01/11/94
Pesticides		
2,2-Bis (p-chlorophenyl)-1,1,1-trichloroethane(DDT)	1 C	3 Cj
2,2-Bis (p-chlorophenyl)-1,1-dichloroethane(DDD)	3 C	10 Cj
2,2-Bis (p-chlorophenyl)-1,1-dichloroethene(DDE)	1 C	3 Cj
Aldrin	10 Cj	0.29 Cj
alpha-Chlordane	4 C	2 Cj
Dieldrin	8 C	6 Cj
Endrin	2 Crr	1 Crr
gamma-Chlordane	4 C	2 Cj
Lindane	ND	0.4 Cj
Herbicides		
2,4-D / 2,4-Dichlorophenoxyaceticacid	0.1 P	4 C
245T	0.19 C	10 Cj
Metals		
Antimony	4.9 b	10.5
Antimony (filtered)	3.7 Fbj	6.5 Fb
Arsenic	82.6	230
Arsenic (filtered)	3.9 F	7.2 Fj
Barium	47.9	181
Cadmium	8.08	40.2
Chromium	10.4	13
Copper	134	306
Copper (filtered)	ND	5.38 F
Iron	17,800	30,800
Iron (filtered)	146 F	115 Fb
Lead	120	110
Manganese	165	298
Manganese (filtered)	19.9 F	37.5 F
Nickel	18.5 b	40.5
Sodium	9730 j/I	43,900 j/I
Sodium (filtered)	10,400 Fj/I	41,700 Fj/I
Vanadium	ND	13.8
Zinc	2090	9240
Zinc (filtered)	45.5 F	495 F

Table 4.27 (continued)

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b	Value is undetected because of method blank contamination; flag applied during independent data validation.
C	Analysis was confirmed
EI	Environmental investigation
F	Sample filtered prior to analysis
j	Value is estimated, flag applied during independent data validation
/I	The low spike recovery is high; qualifier applied during Army data review
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
P	Value is less than reporting limit but greater than instrument detection limit
rr	Value was found unacceptable during independent data validation
μg/l	Micrograms per liter

Table 4.28: Summary of Target Analyte Concentrations Greater than Method Reporting Limits in Sediment Samples Collected at EI Site SM18

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	SM018SE001 0.5 01/11/94	SM018SE002 0.5 01/11/94	SM018SE003 0.5 01/11/94
Pesticides			
2,2-Bis (p-chlorophenyl)-1,1,1-trichloroethane	4.8 Cj	9.1 C	6.1 C
2,2-Bis (p-chlorophenyl)-1,1-dichloroethane	7.2 Cj	23 C	9.2 Cj
2,2-Bis (p-chlorophenyl)-1,1-dichloroethene	2.4 Cj	6.8 C	3.1 C
Aldrin	48 Cj	0.23 C	31 C
alpha-Chlordane	19 Cj	9.1 C	18 C
Dieldrin	48 Cj	23 C	92 C
gamma-Chlordane	24 Cj	11 C	25 C
Heptachlor	ND	ND	0.25 C
Lindane	ND	0.0822 Cj	ND
Herbicides			
2,4-D / 2,4-Dichlorophenoxyaceticacid	ND	1.4 C	ND
245T	ND	1.8 C	ND
MCPP	ND	46 C	ND
Metals			
Antimony	13.5	ND	ND
Arsenic	96 j	910 j	150 j
Barium	113	196	196
Beryllium	ND	ND	3.07
Cadmium	21.4	36.5	19
Chromium	16.1	274	20.6
Cobalt	ND	10.7	7.67
Copper	101	212	92
Cyanide	0.805	1.42	1.07
Iron	22,700	75,300	28,200
Lead	94	1230	76.7
Manganese	289	187	583
Mercury	3.01	4.43	4.33
Nickel	23.4	34.2	33.7
Selenium	0.867 rr	ND	0.982 rr
Sodium	1110	1070	1130
Vanadium	15.9	16.2	24.5
Zinc	5780	9360	3680

C Analysis was confirmed
EI Environmental investigation
j Value is estimated, flag added during independent data validation

Table 4.28 (continued)

mg/kg	Milligrams per kilogram
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
rr	Value was found unacceptable during independent data validation

Table 4.29: Pesticide Mixing and Storage Areas, Building 514 (EI Site SM19), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Surface soil sampling	Pesticides and herbicides	Twelve soil samples collected from the area surrounding Building 514	To assess the potential for pesticides and herbicides in soil near this former pesticide storage location.

EI Environmental investigation

Table 4.30: Summary of Analytes Detected in Surface Soil: EI Site SM19

Analyte (mg/kg) — Site Identification: / Soil Association: / Sample Date:	SM019SS001 M-C 01/10/94	SM019SS002 M-C 01/10/94	SM019SS003 M-C 01/09/94	SM019SS004 M-C 01/10/94	SM019SS005 M-C 01/10/94	SM019SS006 M-C 01/10/94	SM019SS006-DUP M-C 01/10/94
Pesticides							
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	ND	ND	ND	ND	ND	0.0153 C	0.00895 C
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene (DDE)	ND	ND	0.00387 C	ND	ND	0.0079 C	0.00465 C
Aldrin	ND	ND	ND	ND	0.0073 C	0.00377 C	ND
alpha-Chlordane	0.00641 C	0.0103 C	0.0237 C	ND	ND	0.0271 C	0.0298 C
Dieldrin	ND	ND	ND	ND	0.0191 C	0.00731 C	ND
gamma-Chlordane	0.00427 C	0.00601 C	0.0137 C	ND	ND	0.0271 C	0.0358 C
Heptachlor epoxide	ND	ND	0.00474 C	ND	ND	ND	ND
Lindane	ND	ND	ND	ND	ND	0.00696 Cj	ND
Herbicides							
Dichloroprop	ND	ND	ND	0.105 Cj	0.0275 Cj	ND	ND

Table 4.30 (Continued)

Analyte (mg/kg) — Site Identification:	SM019SS007	SM019SS008	SM019SS009	SM019SS010	SM019SS011	SM019SS012
Soil Association:	M-C	M-C	M-C	M-C	M-C	M-C
Sample Date:	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94
Pesticides						
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	0.01 C	ND	ND	ND	ND	0.0629 C
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene (DDE)	ND	ND	ND	ND	ND	0.0552 C
Aldrin	ND	ND	ND	ND	ND	0.0167 Crr
alpha-Chlordane	0.0762 C	ND	ND	0.00732 C	ND	ND
Dieldrin	0.0121 C	ND	ND	ND	ND	ND
gamma-Chlordane	0.0786 C	ND	ND	0.00431 C	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND
Lindane	ND	ND	ND	ND	ND	ND
Herbicides						
Dichloroprop	ND	ND	ND	ND	ND	ND

C Confirmed results
EI Environmental investigation
j Value is estimated, flag added during independent data validation
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
rr Value was found unacceptable during independent data validation

Table 4.31: Pesticide Mixing and Storage Areas - DIS Entomology, Building 605 (EI Site SM20), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Borehole clearance	—	Boring locations	To locate underground utilities so boring locations could be revised to prevent utility damage
Surface soil sampling	Pesticides and herbicides	Twelve samples total; ten samples collected around Buildings 604 and 605 and in the yard and drainage area northeast of Building 605	To assess pesticide and herbicide concentrations in surface soil.
Soil borings and subsurface soil sampling	Pesticides and herbicides	Four borings in open area north to northeast of Building 605; one sample per boring collected for chemical analysis	To assess the vertical extent of soil potentially impacted by pesticides and herbicides.
Surface-water sampling	Pesticides and herbicides	Two surface-water samples collected from water flowing in the drainage channel located northeast of Buildings 604 and 605; one sample was collected approximately 125 feet upstream and one sample was collected 50 feet downstream from the location where runoff from Buildings 604 and 605 enters the drainage channel	To assess aqueous concentrations of pesticides and herbicides.
Sediment sampling	Pesticides and herbicides	Two sediment samples collected from the drainage channel located northeast of Buildings 604 and 605; one sample was collected approximately 125 feet upstream and one sample was collected 50 feet downstream from the location where runoff from Buildings 604 and 605 enters the drainage channel	To assess the potential presence and source of pesticides and herbicides in sediment.

EI Environmental investigation

Table 4.32: Summary of Analytes Detected in Surface Soil: EI Site SM20

Site Identification:	SM020SS001	SM020SS002	SM020SS003	SM020SS004	SM020SS005	SM020SS005-DUP
Soil Association:	M-C	M-C	M-C	M-C	M-C	M-C
Sample Date:	12/21/93	12/21/93	12/21/93	12/21/93	12/21/93	12/21/93
Analyte (mg/kg)						
Pesticides/PCBs						
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	0.4 Cj	0.12 Cj	0.79 Cj	0.85 Cj	0.99 Cj	0.48 DCj
2,2-bis(p-Chlorophenyl)-1,1-dichloroethane (DDD)	ND	0.017 Cj	ND	0.12 Crr	0.25 Cj	0.0155 DCj
2,2-bis(p-Chlorophenyl)-1,1-dichloroethene (DDE)	0.4 Crr	0.12 Cj	0.13 Cj	0.49 Cj	0.87 Cj	0.48 DC
alpha-Chlordane	2.7 Cj	0.00803 Cj	0.0277 Cj	ND	0.00483 Cj	ND
Dieldrin	0.13 Cj	0.97 Cj	0.13 Cj	0.12 Cj	0.0718 Cj	0.0297 DC
Endrin	ND	0.0158 Cj	0.0224 Cj	ND	ND	ND
gamma-Chlordane	4 Cj	0.00657 Crr	0.0356 Cj	0.0207 Crr	0.0186 Crr	ND
Methoxychlor	0.0547 Cj	ND	ND	ND	ND	ND
PCB 1260	1.3 Cj	0.0523 Cj	0.26 Cj	2.4 Cj	2.5 Cj	0.95 DCj
Herbicides						
2,4-D/2,4-Dichlorophenoxyacetic acid	0.53 C	ND	ND	ND	0.0173 C	0.0202 C
Dicamba	0.0333 C	ND	ND	ND	ND	ND

Table 4.32 (Continued)

Analyte (mg/kg) — Site Identification: / Soil Association: / Sample Date:	SM020SS006 M-C 12/21/93	SM020SS007 M-C 12/21/93	SM020SS008 M-C 12/21/93	SM020SS009 M-C 12/21/93	SM020SS010 M-C 12/21/93	SM020SS011 M-C 12/21/93	SM020SS012 M-C 12/21/93
Pesticides/PCBs							
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	0.0907 Cj	0.11 Cj	0.24 Cj	0.71 Cj	6.8 Cj	0.0739 C	0.5 Cj
2,2-bis(p-Chlorophenyl)-1,1-dichloroethane (DDD)	0.0283 Cj	0.0259 Cj	0.0684 Cj	0.0697 Crr	ND	0.0327 Cj	0.0644 Cj
2,2-bis(p-Chlorophenyl)-1,1-dichloroethene (DDE)	0.0907 Cj	0.0614 Cj	0.36 Cj	0.47 C	5.7 Cj	0.12 C	0.12 Cj
alpha-Chlordane	ND	0.0119 Cj	ND	ND	ND	ND	ND
Dieldrin	0.0227 Cj	0.0119 Cj	0.0096 Cj	ND	0.0148 Cj	0.004 C	0.0297 Cj
Endrin	ND	0.00765 Crr	ND	ND	0.00605 Crr	ND	ND
gamma-Chlordane	ND	0.0194 Cj	0.00396 Crr	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND
PCB 1260	0.122 Cj	0.43 Cj	0.0984 Cj	0.0461 Cj	ND	ND	ND
Herbicides							
2,4-D/2,4-Dichlorophenoxyacetic acid	ND	0.014 C	ND	ND	ND	ND	ND
Dicamba	ND	ND	ND	ND	ND	ND	ND

C Analysis was confirmed
D Duplicate sample analysis
EI Environmental investigation
j Value is estimated, flag added during independent data validation
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
rr Value was found unacceptable during independent data validation

Table 4.33: Summary of Analytes Detected in Subsurface Soil: EI Site SM20

Analyte (mg/kg)	Site Identification:	SM020SB001	SM020SB002	SM020SB002-DUP	SM020SB003	SM020SB004
	Depth:	3.5	3	3	3	3.5
	Sample Date:	11/30/93	12/01/93	12/01/93	12/01/93	12/20/93
Pesticides/PCBs						
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane (DDT)		ND	0.00341 C	ND	0.0272 C	ND
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene (DDE)		ND	ND	ND	0.00795 C	ND
alpha-Chlordane		ND	ND	ND	0.0216 C	ND
Dieldrin		ND	ND	ND	0.00511 C	ND
gamma-Chlordane		ND	ND	ND	0.0238 C	ND
PCB 1260		ND	ND	ND	0.0193 C	ND

C Analysis was confirmed
EI Environmental investigation
ND Analyte not detected, or not detected at concentration exceeding background concentrations
mg/kg Milligrams per kilogram
PCB Polychlorinated biphenyl

Table 4.34: Summary of Target Analyte Concentrations Greater than Method Reporting Limits in Surface-Water Samples Collected at EI Site SM20

Analyte (μg/l) — Site Identification: / Sample Date:	SM020SW001 02/15/94	SM020SW001-DUP 02/15/94	SM020SW002 02/15/94
Herbicides			
2,4-D / 2,4-Dichlorophenoxyaceticacid	0.43 C	0.37 C	ND

Ambient Water Quality Criteria not established for 2,4-D (EPA, 1986).

C Confirmed results
EI Environmental investigation
ND Analyte not detected, or not detected at concentration exceeding background concentrations
μg/l Micrograms per liter

Table 4.35: Summary of Target Analyte Concentrations Greater than Method Reporting Limits in Sediment Samples Collected at EI Site SM20

Site Identification:	SM020SE001	SM020SE002
Depth:	0	0.2
Sample Date:	02/15/94	02/15/94
Analyte (mg/kg)		
Pesticides		
2,2-Bis (p-chlorophenyl)-1,1,1-trichloroethane	0.00866 C	ND
Dieldrin	0.0093 C	0.00775 Crr
gamma-Chlordane	0.00388 CjPb	ND

b Analyte detected in associated method blank, flag applied during independent data validation.
C Analysis was confirmed
EI Environmental investigation
j Value is estimated, flag added during independent data validation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
P Value is less than the reporting limit but greater than instrument detection limit; flag applied by laboratory
rr Value was found unacceptable during independent data validation

Table 4.36: Pesticide Mixing and Storage Areas, Building 674 (EI Site SM21), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Surface soil sampling	Pesticides and herbicides	Twelve samples total; eight samples collected in the mixing area north of Building 674; two samples in drainage runoff channel southwest of Building 674; two background samples east and southeast of Building 674	To assess the possible presence of pesticide and herbicide concentrations in surface soil.
Sediment sampling	Pesticides and herbicides	Two sediment samples collected from the drainage channel located south of Building 674; one sample was collected approximately 35 feet upstream and one sample was collected approximately 50 feet downstream from the location where runoff from Building 674 enters the drainage channel	To assess the possible presence and source of pesticides and herbicides in sediment.

EI Environmental investigation

Table 4.37: Summary of Analytes Detected in Surface Soil: EI Site SM21

Site Identification:	SM21SS001	SM21SS002	SM21SS003	SM21SS003-DUP	SM21SS004	SM21SS005	SM21SS006
Soil Association:	G-S	G-S	G-S	G-S	G-S	G-S	G-S
Sample Date:	01/05/94	01/06/94	01/05/94	01/05/94	01/06/94	01/05/94	01/05/94
Analyte (mg/kg)							
Pesticides							
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	ND	ND	ND	0.0305 C	ND	ND	ND
2,2-bis (p-Chlorophenyl)-1,1-dichloroethane (DDD)	ND	ND	ND	ND	ND	ND	ND
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene (DDE)	ND	ND	0.0345 Crr	ND	ND	ND	0.00465 C
alpha-Chlordane	1.5 C	2.2 C	0.27 C	0.53 C	0.43 C	0.0466 C	0.07 C
Dieldrin	ND	ND	ND	0.0159 C	ND	ND	ND
gamma-Chlordane	1.2 C	2.8 C	0.27 C	0.53 C	0.43 C	0.0419 C	0.093 C
Heptachlor	0.0195 C	0.11 Crr	ND	ND	0.0119 C	ND	ND
Heptachlor epoxide	0.12 C	ND	0.0226 C	0.0239 C	ND	ND	ND
Herbicides							
2,4-D / 2,4-Dichloroephenoxyacetic acid	ND	ND	0.0305 C	ND	0.0261 C	ND	0.036 C

Table 4.37 (Continued)

Analyte (mg/kg) — Site Identification: / Soil Association: / Sample Date:	SM21SS007 G-S 01/05/94	SM021SS008 G-S 01/05/94	SM021SS009 G-S 01/06/94	SM021SS010 G-S 01/05/94	SM021SS011 G-S 01/05/94	SM021SS012 G-S 01/05/94
Pesticides						
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	ND	ND	ND	ND	ND	ND
2,2-bis (p-Chlorophenyl)-1,1-dichloroethane (DDD)	0.00606 C	ND	ND	ND	ND	ND
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene (DDE)	0.0136 C	ND	0.00546.Crr	ND	ND	ND
alpha-Chlordane	0.19 C	0.096 C	0.082 C	ND	0.0764 C	0.0487 C
Dieldrin	ND	0.00502 C	0.00546 C	ND	ND	0.00635 Crr
gamma-Chlordane	0.19 C	0.072 C	0.037 C	ND	0.0653 C	0.0458 C
Heptachlor	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	0.0107 C	0.00646 C	0.0116 C	ND	ND	ND
Herbicides						
2,4-D / 2,4-Dichlorophenoxyacetic acid	ND	ND	ND	ND	ND	ND

rr Value was found unacceptable during independent data validation
C Analysis was confirmed
EI Environmental investigation
G-S Genesee-Sloan soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentrations exceeding background concentration

Table 4.38: Summary of Target Analyte Concentrations Greater than Method Reporting Limits in Sediment Samples Collected at EI Site SM21

Analyte (mg/kg)	Site Identification:	SM021SE001	SM021SE002
	Depth:	0	0.2
	Sample Date:	01/05/94	01/05/94
Pesticides			
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane(DDT)		0.00603 C	ND
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene(DDE)		0.0065 C	ND
alpha-Chlordane		ND	0.55 C
gamma-Chlordane		ND	0.55 C
Heptachlor epoxide		ND	0.0178 C

C Analysis was confirmed
EI Environmental investigation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.39: Firing Range - Foreman Rifle Range, Near Buildings 811 and 812 (EI Site SM22), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Surface soil sampling	Total metals; mass of metal in sieved soil sample	Twenty-two soil samples at 11 locations from surface of hillside impacted by firing range usage; at each sampling location, one sample for chemical analysis and one sample for bullet fragment analysis	To assess average total metal content in surface soil.
Soil borings and subsurface soil sampling	Total metals; mass of metal in sieved soil samples	Five borings colocated with five surface soil samples across the face of the firing range hill-side impacted by firing range usage; one sample per boring for chemical analysis; bullet fragment analysis on remainder of sample	To assess possible leaching and deposition of metals.
Surface-water sampling	Total and dissolved metals	Two surface-water samples from Schoen Creek. One surface-water sample approximately 25 feet upstream of impacted hillside and one sample approximately 25 feet downstream of impacted hillside	To assess possible leaching, movement, and loading of metals.
Sediment sampling	Total metals	Two sediment samples from Schoen Creek. One stream sediment sample in stream bed approximately 25 feet upstream of impacted hill-side and one sample approximately 25 feet downstream of impacted hillside	To assess possible leaching and deposition of metals.

EI Environmental investigation

Table 4.40: Summary of Analyte Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM22

Site Identification:	SM022SS001	SM022SS002	SM022SS003	SM022SS004	SM022SS005	SM022SS006
Soil Association:	G-S	G-S	G-S	G-S	G-S	G-S
Sample Date:	01/06/94	01/06/94	01/06/94	01/06/94	01/06/94	01/06/94
Analyte (mg/kg)						
Metals						
Antimony	100	583	11.8	255	ND	11.7
Arsenic	13 j	24 j	9.4 j	7.6 j	ND	ND
Beryllium	ND	ND	ND	ND	ND	0.757
Copper	95.1 j	535 j	118 j	98.1 j	34.8 j	29 j
Cyanide	ND	ND	ND	ND	ND	ND
Lead	9890	36,000	1060	25,000	74.3	1260
Silver	ND	1.34	ND	0.637 P	0.767	ND
Thallium	ND	ND	ND	ND	ND	ND
Zinc	ND	134	85	84.1	ND	ND

Table 4.40 (continued)

Site Identification:	SM022SS007	SM022SS008	SM022SS009	SM022SS010	SM022SS011
Soil Association:	G-S	G-S	G-S	G-S	G-S
Sample Date:	01/06/94	01/06/94	01/06/94	01/06/94	01/06/94
Analyte (mg/kg)					
Metals					
Antimony	45.3	543	56.2	203	56.5
Arsenic	8.83 j	31 j	24 j	32 j	11.2 j
Beryllium	ND	ND	ND	ND	ND
Copper	128 j	3090 j	872 j	1270 j	115 j
Cyanide	ND	ND	0.381	ND	ND
Lead	5340	49,000	6210	25,000	4360
Silver	ND	1.85	ND	0.647	ND
Thallium	ND	13.6	ND	ND	ND
Zinc	ND	395	143	279	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
G-S Genesee-Sloan soil association
j Value is estimated, flag applied during independent data validation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentrations exceeding background concentration
P Value is less than reporting limit, but greater than instrument detection limit

Table 4.41: Summary of Metals Concentrations in Subsurface Soil that are Greater than Background Concentrations: EI Site SM22

Site Identification:	SM022SB001	SM022SB002	SM022SB002-DUP	SM022SB003	SM022SB004	SM022SB005
Depth:	2.5	2.5	2.8	2.5	2.5	2.4
Sample Date:	01/06/94	01/06/94	01/06/94	01/06/94	01/06/94	01/06/94
Analyte (mg/kg)						
Metals						
Antimony	ND	ND	ND	ND	ND	31.4
Arsenic	ND	ND	7.43 Dj	ND	ND	ND
Copper	32.8 j	60.2 j	ND	ND	ND	64.1 j
Lead	516	486	24 D	31	46.5	3920
Manganese	ND	ND	754 D	ND	ND	ND
Mercury	ND	ND	ND	0.126	ND	ND
Silver	ND	ND	ND	0.747	ND	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D Duplicate sample analysis
EI Environmental investigation
j Value is estimated, flag added during independent data validation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.42: Bullet Fragment Analysis Results for Foreman Rifle Range: EI Site SM22

Sample Identification	Sample Depth (feet)	Mass of Soil (dry) and Bullets (grams)	Mass of Bullet Fragments (grams)	Percent Bullet Fragments
SM022SS001	0.0 - 0.5	1020.30	83.53	8.19
SM022SB001	0.5 - 1.0	1062.40	70.10	6.60
	1.0 - 1.5	629.27	64.58	10.26
	1.5 - 2.0	847.72	32.86	3.88
	2.0 - 2.5	1099.93	0.00	0.00
SM022SS002	0.0 - 0.5	994.69	159.05	15.99
SM022SB002	0.5 - 1.0	1004.13	28.41	2.83
	1.0 - 1.5	1036.55	19.80	1.91
	1.5 - 2.0	1121.28	52.10	4.65
	2.0 - 2.5	1135.71	0.28	0.02
SM022SS003	0.0 - 0.5	893.03	34.52	3.87
SM022SB004	0.5 - 1.0	1106.73	0.35	0.03
	1.0 - 1.5	1105.85	7.97	0.72
	1.5 - 2.0	1078.24	0.10	0.01
	2.0 - 2.5	1166.04	2.10	0.18
SM022SS004	0.0 - 0.5	970.65	12.71	1.31
SM022SB004	0.5 - 1.0	1177.62	0.00	0.00
	1.0 - 1.5	1162.38	4.80	0.41
	1.5 - 2.0	1089.27	0.00	0.00
	2.0 - 2.5	1166.37	0.00	0.00
SM022SS005	0.0 - 0.5	662.00	30.72	4.64
SM022SB005	0.5 - 1.0	1064.29	0.46	0.04
	1.0 - 1.5	1023.94	0.00	0.00
	1.5 - 2.0	997.55	4.60	0.46
	2.0 - 2.5	646.28	0.13	0.02
SM022SS006	0.0 - 0.5	473.51	1.98	0.42
SM022SS007	0.0 - 0.5	374.30	30.06	8.03
SM022SS008	0.0 - 0.5	615.05	116.02	18.86
SM022SS009	0.0 - 0.5	465.63	66.94	14.38
SM022SS010	0.0 - 0.5	498.62	14.60	2.93
SM022SS011	0.0 - 0.5	257.81	8.78	3.41

Soil samples were collected on January 6, 1994.

EI Environmental investigation

Table 4.43: Comparison of Surface-Water Loading for Detected Analytes: EI Site SM22

	AWQC[a]		SM022SW02 Upstream Sample Flow Rate = 43.73 l/s		SM022SW001 Downstream Sample Flow Rate = 43.73 l/s	
Analyte	Acute (μg/l)	Chronic (μg/l)	Concentration (μg/l)	Load (grams/s)	Concentration (μg/l)	Load (grams/s)
Total Metals						
Barium	NE	NE	74.80	0.0037	62.10	0.003
Copper	18[b]	12[b]	11.40	0.005	6.36	2.8×10^{-4}
Iron	NE	1,000	1720[c] j	0.075	458 j	0.02
Lead	82[b]	3.2[b]	1.0[d]	4.4×10^{-5}	3.00	1.3×10^{-4}
Manganese	NE	NE	102.00	0.004	45.50	0.002
Sodium	NE	NE	93,300 /I	4.07	94,700 /I	4.14
Zinc	120[b]	110[b]	20.30	8.9×10^{-4}	10.00	4.4×10^{-4}
Dissolved Metals						
Antimony	9000[e]	1600[e]	5.20 F rr	2.3×10^{-4}	5.20 rr	2.3×10^{-4}
Barium	NE	NE	58.30 F	0.002	60.80 F	0.003
Iron	NE	1,000	22.5[d]	9.8×10^{-4}	53.50 Fj	0.002
Manganese	NE	NE	32.40 F	0.001	35.10 F	0.002
Sodium	NE	NE	95,000 F/I	4.15	96,800 F/I	4.23

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

AWQC	Ambient Water Quality Criteria
EI	Environmental investigation
F	Filtered
/I	The low spike recovery is high; qualifier applied during Army data review
j	Value is estimated flag, added during independent data valuation
l/s	Liters per second
mg/l	Milligrams per liter
NE	Ambient Water Quality Criteria not established
rr	Value was found unacceptable during independent data validation
μg/l	Micrograms per liter

a. U.S. Environmental Protection Agency (EPA, 1986)
b. Hardness dependent criteria, based on 100 mg/l calcium carbonate ($CaCO_3$)
c. Value exceeds AWQC chronic criteria
d. Analyte not detected; value shown is equal to one half the reporting limit
e. Insufficient data to develop criteria. Value presented is the lowest observed effect level (LOEL).

Table 4.44: Summary of Metals Concentrations Greater than Method Reporting Levels in Sediment Samples Collected at EI Site SM22

Site Identification:	SM022SE002	SM022SE001
Depth:	0.5	0.5
Sample Date:	02/16/94	02/16/94
Analyte (mg/kg)		
Metals		
Arsenic	4.21 j	9.42 j
Barium	NA	84.2
Chromium	9.56	15.2
Cobalt	4.21	7.01
Copper	22.9	80.2
Iron	10900	16800
Lead	24.9	361
Manganese	363	962
Nickel	11.9	19.8
Sodium	707	822
Vanadium	14.3	20
Zinc	59.3	144

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
j Value is estimated, flag applied during independent data validation
ND Analyte not detected, or not detected at concentration exceeding background concentrations
mg/kg Milligrams per kilogram

Table 4.45: Firing Range - State Police Pistol Range, Near Building 815 (EI Site SM23), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Surface soil sampling	Total metals; mass of metal in sieved soil sample	Twenty soil samples from 10 locations across the surface of the hillside impacted by the firing range usage; at each sampling location, one sample for chemical analysis and one sample for bullet fragment analysis	To assess average total metal content in surface soil.
Soil borings and subsurface soil sampling	Total metals; mass of metals in sieved soil samples	Five borings spaced across the face of the firing range hillside impacted by firing range usage; locations were colocated with five surface soil samples; one sample per boring for chemical analysis; bullet fragment analysis on remainder of sample	To assess possible leaching and deposition of metals.
Surface-water sampling	Total and dissolved metals	Two surface water samples from Lawrence Creek. One surface-water sample approximately 50 feet upstream of impacted hillside and one sample approximately 25 feet downstream of impacted hillside	To assess possible leaching, movement, and loading of metals.
Sediment sampling	Total metals	Two sediment samples from Lawrence Creek. One stream sediment sample in stream bed approximately 50 feet upstream of impacted hillside and one sample approximately 25 feet downstream of impacted hillside	To assess possible leaching and deposition of metals.

EI Environmental investigation

Table 4.46: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM23

Site Identification:	SM023SS001	SM023SS002	SM023SS003	SM023SS004	SM023SS005	SM023SS005-DUP
Soil Association:	G-S	G-S	G-S	G-S	G-S	G-S
Sample Date:	12/08/93	12/08/93	12/08/93	12/08/93	12/08/93	12/08/93
Analyte (mg/kg)						
Metals						
Antimony	684	23.9	10	1540	12.3	32.2 D
Arsenic	14 j/I	ND	8.9 j/I	15 j/I	19 j/I	700 Dj/I
Cobalt	ND	ND	ND	ND	ND	ND
Copper	180 j	45.3 j	24.5 j	165 j	55.5 j	60.1 Dj
Lead	96,000 j	3100 j	523 j	99,000 j	798 j	1680 Dj
Nickel	32.4 j	ND	ND	ND	ND	ND
Silver	5.16 j	ND	ND	2.09 j	ND	ND
Sodium	ND	ND	ND	ND	785	448 D
Thallium	100 j	27.4 j	21.1 j	100 j	28.4 j	28 Dj

Table 4.46 (Continued)

Site Identification: / Soil Association: / Sample Date: / Analyte (mg/kg)	SM023SS006 G-S 12/08/93	SM023SS007 G-S 12/08/93	SM023SS008 G-S 12/08/93	SM023SS009 G-S 12/08/93	SM023SS010 G-S 12/08/93
Metals					
Antimony	524	18.5	488	13.4	ND
Arsenic	ND	46 j/I	11 j/I	24 j/I	7.7 j/I
Cobalt	ND	ND	ND	10.7	ND
Copper	54.8 j	26.6 j	261 j	91.2 j	20.6 j
Lead	37,000 j	2660 j	68,000 j	1740 j	180 j
Nickel	ND	ND	ND	33.5 j	ND
Silver	ND	ND	1.36 j	ND	ND
Sodium	ND	ND	ND	ND	412
Thallium	100 j	28.9 j	100 j	20.1 j	32.2 j

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D Duplicate sample analysis
EI Environmental investigation
G-S Genesee-Sloan soil association
/I The low-spike recovery is high; qualifier applied during Army data review
j Value is estimated, flag applied during independent data validation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.47: Summary of Metals in Subsurface Soil that are Greater than Background Concentrations: EI Site SM23

Analyte (mg/kg)	Site Identification:	SM023SB001	SM023SB002	SM023SB003	SM023SB004	SM023SB004-DUP	SM023SB005
	Depth:	2.5	2.4	2.5	2.5	2.5	2.5
	Sample Date:	12/09/93	12/09/93	12/09/93	12/09/93	12/09/93	12/09/93
Metals							
Copper		ND	ND	31.7 j	ND	ND	ND
Lead		ND	58.2 j	164 j	93.8 j	30.1 Dj	230 j
Manganese		ND	ND	528	ND	ND	ND
Nickel		ND	ND	34 j	ND	ND	ND
Sodium		ND	ND	ND	ND	424 D	449
Thallium		28.7 j	27.4 j	ND	23.7 j	29 Dj	26.5 j

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D	Duplicate sample analysis
EI	Environmental investigation
j	Value is estimated, flag applied during independent data validation
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
mg/kg	Milligrams per kilogram

Table 4.48: Bullet Fragment Analysis Results for State Police Pistol Range, Near Building 815 (EI Site SM23), Fort Benjamin Harrison

Sample Identification	Sample Depth (feet)	Mass of Soil (dry) and Bullets (grams)	Mass of Bullet Fragments (grams)	Percent Bullet Fragments
SM023SS001	0.0 - 0.5	1612.80	472.00	29.27
SM023SB001	0.5 - 1.0	1687.90	31.00	1.84
	1.0 - 1.5	2011.70	1.90	0.09
	1.5 - 2.0	888.70	15.50	1.74
	2.0 - 2.5	2386.60	2.70	0.11
SM023SS002	0.0 - 0.5	1725.00	210.90	12.23
SM023SB002	0.5 - 1.0	1676.60	16.20	0.97
	1.0 - 1.5	2692.20	17.30	0.64
	1.5 - 2.0	1676.20	55.30	3.30
	2.0 - 2.5	2040.70	9.00	0.44
SM023SS003	0.0 - 0.5	1649.60	278.10	16.86
SM023SB003	0.5 - 1.0	1585.00	57.40	3.62
	1.0 - 1.5	2368.30	19.40	0.82
	1.5 - 2.0	1770.40	20.60	1.16
	2.0 - 2.5	1763.30	19.40	1.10
SM023SS004	0.0 - 0.5	3051.81	1527.75	50.06
SM023SB004	0.5 - 1.0	1592.91	272.04	17.08
	1.0 - 1.5	1297.22	13.05	1.01
	1.5 - 2.0	1474.62	0.51	0.03
	2.0 - 2.5	1601.50	2.91	0.18
SM023SS005	0.0 - 0.5	334.96	24.41	7.29
SM023SB005	0.5 - 1.0	364.72	20.81	5.71
	1.0 - 1.5	1088.90	0.00	0.00
	1.5 - 2.0	1658.72	0.00	0.00
	2.0 - 2.5	353.04	0.00	0.00
SM023SS006	0.0 - 0.5	544.85	186.22	34.18
SM023SS007	0.0 - 0.5	542.08	176.50	32.56
SM023SS008	0.0 - 0.5	1168.83	522.80	44.73
SM023SS009	0.0 - 0.5	661.20	11.67	1.76
SM023SS010	0.0 - 0.5	752.67	1.31	0.17

Soil samples were collected on December 8 and 9, 1993.

EI Environmental investigation

Table 4.49: Comparison of Surface-Water Loading for Detected Analytes: EI Site SM23

	AWQC[a]		Downstream Sample Flow Rate = 41 l/s		Upstream Sample Flow Rate = 50.5 l/s	
Analyte	Acute (μg/l)	Chronic (μg/l)	SM023SW001 (μg/l)	Load (grams/s)	SM023SW002[b] (μg/l)	Load (grams/s)
Total Metals						
Barium	NE	NE	80.60	0.003	89.7	4.5×10^{-3}
Iron	NE	1,000	413 j	0.017	1,515.00[c] j	0.076
Lead	82[d]	3.2[d]	1.0°	4.13×10^{-5}	3.55[c]	1.8×10^{-4}
Manganese	NE	NE	46.50	0.002	74.10	0.004
Sodium	NE	NE	86,200 /I	3.56	88,450 /I	4.47
Dissolved Metals						
Antimony	9000[f]	1600[f]	5.20 F rr	2.1×10^{-4}	4.85 F rr	2.4×10^{-4}
Barium	NE	NE	77.30 F	0.003	79.20 F	0.004
Copper	18[d]	12[d]	5.70 F	2.35×10^{-4}	5.61 F	2.8×10^{-4}
Iron	NE	1,000	22.5°	9.3×10^{-4}	67.55 F	0.003
Lead	82[d]	3.2[d]	1.0°	4.1×10^{-5}	4.20[d] F b	2.1×10^{-4}
Manganese	NE	NE	43.10 F	0.002	46.70 F	0.002
Sodium	NE	NE	86,900 F/I	3.58	88,350 F/I	4.46

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

AWQC	Ambient Water Quality Criteria
b	Value is undetected because of method blank contamination; flag applied during independent data validation
EI	Environmental investigation
F	Filtered
/I	The low spike recovery is high; qualifier applied during Army data review
j	Value is estimated, flag applied during independent data validation
l/s	Liters per second
NE	Ambient Water Quality Criteria not established
rr	Value was found unacceptable during independent data validation
μg/l	Micrograms per liter

a. U.S. Environmental Agency (EPA, 1986).
b. Averaged analytical results for investigative and duplicate samples.
c. Value exceeds AWQC chronic criteria.
d. Hardness dependent criteria, based on a hardness of 100 milligrams per liter calcium carbonate ($CaCO_3$).

Table 4.49 (Continued)

e. Analyte not detected; values shown are equal to one half the reporting limit.
f. Insufficient data to develop criteria. Value presented is the lowest observed effect level (LOEL).

Table 4.50: Summary of Target Analyte Concentrations Greater than Method Reporting Limit in Sediment Samples Collected at EI Site SM23

Site Identification:	SM023SE001	SM023SE002
Depth:	0	0
Sample Date:	02/17/94	02/17/94
Analyte (mg/kg)		
Metals		
Antimony	ND	28.4 j
Arsenic	4.76 j	8.15 j
Chromium	5.26	8.77
Cobalt	3.51	5.19
Copper	8.4	14.8
Iron	6520	11,600
Lead	6.52	827
Manganese	201	284
Nickel	9.27	14.8
Sodium	489	506
Vanadium	8.4	13.6
Zinc	28.8	32.1

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
j Value is estimated, flag applied during independent data validation
ND Analyte not detected, or not detected at concentration exceeding background concentrations
mg/kg Milligrams per kilogram

Table 4.51: Firing Range - Skeet/Rifle Range, Near Buildings 819 through 822 (EI Site SM24), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	---	Available historical site maps, plans, and records and site personnel interviews	To gather information on the site used as a rifle range to identify area(s) of spent shot or bullet impact for sampling purposes.
Surface soil sampling	Total metals; mass of metal in sieved soil sample	Thirty-four soil samples from 17 locations impacted by spent shot or bullets; locations were selected after performing a visual survey. At each sampling location, one sample for chemical analysis and one for skeet/bullet fragment analysis	To assess average total metals content in surface soil.
Soil borings and sub-surface soil sampling	Total metals; mass of metal in sieved soil samples	Six borings spaced across the skeet/rifle range impacted by range usage; locations were colocated with six surface soil samples; one sample per boring for chemical analysis; shot/bullet fragment analysis on remainder of sample.	To assess possible leaching and deposition of metals.

--- Not applicable
EI Environmental investigation

Table 4.52: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM24

Site Identification:	SM024SS001	SM024SS001-DUP	SM024SS002	SM024SS003	SM024SS004	SM024SS005
Soil Association:	G-S	G-S	G-S	G-S	G-S	G-S
Sample Date:	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94
Analyte (mg/kg)						
Metals						
Antimony	ND	ND	ND	ND	350 j	14,000 j
Arsenic	970 j	11 Dj	21 j	7.39 j	17 j	1200 j
Barium	ND	ND	ND	ND	ND	ND
Cadmium	0.858	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND
Cobalt	9.22	9.92 D	ND	ND	ND	ND
Copper	24.3	26 D	ND	22.3	26.5	29
Iron	ND	ND	ND	ND	ND	ND
Lead	340	423 D	859	126	56,000	110,000
Mercury	ND	ND	ND	ND	0.363	ND
Nickel	ND	21.1 D	ND	ND	ND	ND
Selenium	1.2 rr	0.959 Dj/N	ND	ND	ND	1.2 rr/N
Silver	ND	ND	ND	ND	3.21	9.52
Sodium	534	650 D	430	ND	488	ND
Vanadium	ND	ND	ND	ND	ND	ND
Zinc	102	104 D	ND	87.9	82.3	ND

Table 4.52 (continued)

Site Identification:	SM024SS006	SM024SS007	SM024SS008	SM024SS009	SM024SS010	SM024SS010-DUP
Soil Association:	G-S	G-S	G-S	G-S	G-S	G-S
Sample Date:	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94
Analyte (mg/kg)						
Metals						
Antimony	ND	3100 j	1400 j	ND	78.1 j	4800 Dj
Arsenic	8 j	15 j	84 j	14 j	25 j	91 Drr
Barium	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND
Copper	ND	ND	25.7	ND	25	64.2 D
Iron	ND	ND	ND	ND	ND	ND
Lead	65.8	120,000	57,000	455	6880	96,000 D
Mercury	ND	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	ND
Selenium	0.5 rr/N	ND	0.5 rr/N	ND	ND	ND
Silver	ND	2.64	2.71	ND	ND	1.03 D
Sodium	ND	467	ND	ND	563	610 D
Vanadium	ND	ND	ND	ND	ND	ND
Zinc	ND	ND	ND	ND	89.1	ND

Table 4.52 (continued)

Site Identification:	SM024SS011	SM024SS012	SM024SS013	SM024SS014	SM024SS015	SM024SS016	SM024SS017
Soil Association:	G-S	G-S	G-S	G-S	G-S	G-S	G-S
Sample Date:	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94
Analyte (mg/kg)							
Metals							
Antimony	ND	880 j	ND	ND	ND	ND	ND
Arsenic	ND	140 j	8.4 j	9.6 j	9.7 j	1700 j	8.1 j
Barium	ND	ND	ND	ND	ND	118	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	18.9	21.2	ND
Cobalt	ND	ND	ND	ND	ND	ND	9.42
Copper	ND	20.5	ND	ND	ND	27.3	21.1
Iron	ND	ND	ND	ND	20,300	22,700	ND
Lead	119	100,000	83	226	135	1320	308
Mercury	ND	ND	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	21.7	24.2	ND
Selenium	ND	0.41 rr/N	ND	ND	ND	1.2 rr/N	ND
Silver	ND	2.78	ND	ND	ND	ND	ND
Sodium	ND	439	ND	ND	487	621	568
Vanadium	ND	ND	ND	ND	36.5	40.9	ND
Zinc	ND	ND	ND	ND	ND	121	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D	Duplicate sample analysis
EI	Environmental investigation
G-S	Genesee-Sloan soil association
j	Value is estimated, flag added during independent data validation
mg/kg	Milligrams per kilogram
/N	The high-spike recovery is low; qualifier applied during Army data review
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
rr	Value was found unacceptable during independent data validation

Table 4.53: Summary of Analyte Concentrations in Subsurface Soil that are Greater than Background Concentrations: EI Site SM24

Site Identification:	SM024SB001	SM024SB002	SM024SB002-DUP	SM024SB003	SM024SB004	SM024SB005	SM024SB007
Depth:	2.5	2	2.5	0.8	2	2.5	2.5
Sample Date:	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94
Analyte (mg/kg)							
Metals							
Lead	ND	27	ND	89.4	ND	63	ND
Manganese	ND	ND	ND	544	638	ND	ND
Mercury	ND	ND	ND	ND	0.215	ND	ND
Selenium	ND	ND	ND	0.5 rr/N	ND	ND	ND
Silver	ND	ND	ND	0.907	3.01	ND	ND
Sodium	514	457	418 D	427	433	461	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D Duplicate sample analysis
EI Environmental investigation
mg/kg Milligrams per kilogram
/N The high spike recovery is low, qualifier applied during Army data review
ND Analyte not detected, or not detected at concentration exceeding background concentrations
rr Value was found unacceptable during independent data validation

Table 4.54: Bullet Fragment Analysis Results for Skeet/Rifle Range, Near Buildings 819 through 822 (EI Site SM24), Fort Benjamin Harrison

Sample Identification	Sample Depth (feet)	Mass of Soil (dry) and Bullets (grams)	Mass of Bullet Fragments (grams)	Percent Bullet Fragments
SM024SS001	0.0 - 0.5	263.90	5.40	2.05
SM024SB001	0.5 - 1.0	1144.50	0.20	0.02
	1.0 - 1.5	958.70	0.00	0.00
	1.5 - 2.0	1150.60	0.00	0.00
	2.0 - 2.5	1162.35	0.70	0.06
SM024SS002	0.0 - 0.5	381.00	4.50	1.18
SM024SB002	0.5 - 1.0	1147.70	0.30	0.03
	1.0 - 1.5	1179.00	0.05	0.00
	1.5 - 2.0	1150.30	0.05	0.00
	2.0 - 2.5	1159.70	0.00	0.00
SM024SS003	0.0 - 0.5	375.00	33.25	8.87
SM024SB003	0.5 - 1.0	1225.50	0.05	0.00
	1.0 - 1.5	1020.95	0.05	0.00
	1.5 - 2.0	1241.80	0.00	0.00
	2.0 - 2.5	1423.30	0.00	0.00
SM024SS004	0.0 - 0.5	609.50	26.90	4.41
SM024SB004	0.5 - 1.0	965.00	0.90	0.09
	1.0 - 1.5	1334.20	1.65	0.12
	1.5 - 2.0	1013.90	0.05	0.00
	2.0 - 2.5	1044.00	0.05	0.00
SM024SS005	0.0 - 0.5	411.65	77.20	18.75
SM024SB005	0.5 - 1.0	859.50	1.10	0.13
	1.0 - 1.5	1174.30	0.50	0.04
	1.5 - 2.0	1479.00	0.20	0.01
	2.0 - 2.5	1016.20	0.00	0.00
SM024SS006	0.0 - 0.5	200.60	0.10	0.05
SM024SS007	0.0 - 0.5	392.00	10.00	2.55
SM024SB007	0.5 - 1.0	1043.70	0.10	0.01
	1.0 - 1.5	1033.60	0.05	0.00
	1.5 - 2.0	1005.00	0.05	0.00
	2.0 - 2.5	1271.20	0.05	0.00
SM024SS008[a]	0.0 - 0.5	543.15	12.00	2.21
SM024SS009[b]	0.0 - 0.5	358.30	19.50	5.44
SM024SS010[c]	0.0 - 0.5	368.70	52.50	14.24
SM024SS011	0.0 - 0.5	501.95	0.20	0.04
SM024SS012	0.0 - 0.5	644.50	53.50	8.30
SM024SS013	0.0 - 0.5	647.35	0.30	0.05
SM024SS014	0.0 - 0.5	383.40	9.50	2.48
SM024SS015	0.0 - 0.5	316.80	0.50	0.16
SM024SS016	0.0 - 0.5	537.00	12.10	2.25
SM024SS017	0.0 - 0.5	129.00	0.70	0.54

Table 4.54 (continued)

Soil samples were collected on February 19, 1994, and April 6, 1994.

EI Environmental investigation

a. Includes 0.28 percent due to weight of bullet cartridge(s)
b. Includes 4.05 percent due to weight of bullet cartridge(s)
c. Includes 4.07 percent due to weight of bullet cartridge(s)

Table 4.55: Historic Military Sites (EI Sites SM25a through k) Being Investigated as Potential Sources of Contamination

Historic Military Site	Description	Site Type	Period of Use
SM25a	World War I entrenchment	WWI	1917 to 1918
SM25b	World War I dump	WWI	1889 to 1913
SM25c	World War I dump	WWI	1890 to 1920
SM25d	Dump World War II military dump	Ag WWII	Ca 1900 1946 to 1947
SM25e	F.M. Kimberlain homestead World War II dump	Ag WWII	1866 to 1945 -
SM25f	Lord Hall area (military dump)	WWII	1947
SM25g	World War I entrenchments	WWI	1917 to 1918
SM25h	Prehistoric campsite Military dump	Preh WWII	Unknown 1930 to 1950
SM25i	Military historic scatter	WWI	Ca 1908+
SM25j	Military dump	WWI	Ca 1908+
SM25k	Military dump	WWII	1933+
SM25l	Hand Grenade Practice Range	Unknown	Unknown

Source: Weston, 1992.

Ag	Historically agricultural
Ca	Circa
EI	Environmental investigation
Preh	Prehistoric
WWI	World War I
WWII	World War II

Table 4.56: Historic Military Sites (EI Site SM25b), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	-	SM25b	To assess past use, extent, and potential for containing hazardous waste and hazardous constituents.
Limited geophysical survey	GPR and EM	Limited geophysical survey performed on portion of site believed to be beneath the edge of the golf course	To evaluate the geometry of historic sites and assess the presence of buried metal objects.
Test soil boring	-	One test boring was hand augered near the center of the site to a depth of 5 feet	To assess possible presence of subsurface debris.
Surface soil sampling	SVOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters	Six surface soil samples collected from portion of site within wooded area where some glass fragments were observed	To assess possible presence of hazardous constituents in surface soil.

Landfill parameters include fluoride, nitrates, hardness, sulfate, chloride, total organic carbon, chemical oxygen demand, boron, alkalinity, total dissolved solids (TDS), pH, biochemical oxygen demand 5 (five-day test), ammonia, specific conductivity, and total phenolic compounds.

- Not applicable
EI Environmental investigation
EM Electromagnetics
GPR Ground penetrating radar
PCBs Polychlorinated biphenyls
SVOCs Semivolatile organic compounds
VOCs Volatile organic compounds

Table 4.57: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM25b

Analyte (mg/kg)	Site Identification: / Soil Association: / Sample Date	SM25BSS001 M-C 02/07/94	SM25BSS001-DUP M-C 02/07/94	SM25BSS002 M-C 02/07/94	SM25BSS003 M-C 02/07/94	SM25BSS004 M-C 02/07/94	SM25BSS005 M-C 02/07/94	SM25BSS006 M-C 02/07/94
Metals								
Cadmium		ND	0.666 D	ND	ND	ND	ND	ND
Cobalt		ND	ND	8.67	9.7	ND	9.07	ND
Copper		ND	25.1 D	ND	ND	ND	ND	ND
Iron		ND	18800 D	ND	ND	ND	ND	ND
Lead		121	126 D	49.9	ND	ND	ND	ND
Mercury		0.355	0.322 D	ND	ND	ND	ND	ND
Nickel		ND	ND	ND	ND	18.9	19.5	ND
Sodium		ND	ND	ND	ND	ND	ND	489
Zinc		94.2	98 D	92	ND	ND	ND	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D Duplicate sample analysis
EI Environmental investigation
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.58: Summary of Analytes Detected in Surface Soil: EI Site SM25b

Analyte (mg/kg) — Site Identification: / Soil Association: / Sample Date	SM25BSS001 M-C 02/07/94	SM25BSS001-DUP M-C 02/07/94	SM25BSS002 M-C 02/07/94	SM25BSS003 M-C 02/07/94	SM25BSS004 M-C 02/07/94	SM25BSS005 M-C 02/07/94	SM25BSS006 M-C 02/07/94
SVOCs							
Anthracene	0.23	0.21 D	ND	ND	ND	ND	ND
Benzo[a]anthracene	1.2	1 D	ND	ND	ND	ND	ND
Benzo[a]pyrene	1.3	1.2 D	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	1.8	1.5 D	ND	ND	ND	ND	ND
Benzo[e]pyrene	0.85 S	0.75 S	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	0.93	0.83 D	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	0.76	0.68 D	ND	ND	ND	ND	ND
bis(2-Ethylhexyl) phthalate	1.9 Bb	0.41 DBb	ND	3.7 Bb	ND	0.38 Bb	ND
Chrysene	1.4	1.3 D	ND	ND	ND	ND	ND
Dibenzo[a,h]anthracene	0.25	0.21 D	ND	ND	ND	ND	ND
Docosane	ND	0.5 Sj	ND	ND	ND	ND	ND
Eicosane	ND	0.63 Sj	ND	ND	ND	ND	ND
Fluoranthene	2.3	2.1 D	0.18 JP	ND	ND	ND	ND
Heneicosane	0.36 S	1 S	ND	ND	ND	ND	ND
Heptacosane	ND	ND	0.53 S	ND	ND	0.56 S	ND
Indeno[1,2,3-c,d]pyrene	1	0.9 D	ND	ND	ND	ND	ND
Nonacosane	0.97 S	0.88 S	0.66 S	0.41 S	ND	2.8 S	1.5 S
Palmitic acid/hexadecanoic acid	0.36 S	0.75 S	ND	ND	ND	ND	0.46 S
Phenanthrene	1	0.95 D	ND	ND	ND	ND	ND
Pyrene	1.9	1.6 D	ND	ND	ND	ND	ND
r-Sitosterol/(3B,24s)-stigmast-5-en-3-ol/clionaste	ND	0.75 S	ND	0.41 S	ND	1.4 S	3.1 S
Tricosane/n-tricosane	ND	0.38 Sj	ND	ND	ND	ND	ND
Pesticides							
beta-Benzenehexachloride	ND	ND	ND	0.0205 C	ND	ND	ND
Landfill Parameters							
Ammonia	232	190	238	249	156	129	231
Fluoride	ND	ND	3.84 bj	3.99 bj	3.94 bj	ND	ND
pH	7.8	7.6	6.3 rr	6.7 rr	7.8 rr	7.4 rr	7.6 rr
Nitrate/nitrate	7.27	5.39 D	7.48 j	6.37	3.92 j	7.95 j	3.19 j
Total organic carbon	44000 j	26000 Dj	28000 j	25000 j	18000 j	23000 j	38000 j
Total recoverable phenolics	2.29	1.73 Db	1.63 b	2.04 b	2.92 b	2.71 b	3.11 b

Table 4.58 (Continued)

b	Value is undetected because of method blank contamination, flag applied during independent data validation
B	Analyte detected in associated method blank, flag applied by laboratory
C	Analysis was confirmed
D	Duplicate sample analysis
EI	Environmental investigation
j	Value is estimated, flag added during independent data validation
M-C	Miami-Crosby soil association
mg/kg	Milligrams per kilogram
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
rr	Value was found unacceptable during independent data validation
S	Nontarget analyte analyzed for and detected (gas chromatography/mass spectrometry methods)
SVOCs	Semivolatile organic compounds

* Value compared to Indiana Department of Environmental Management-provided background value.

Table 4.59: Historic Military Sites (EI Site SM25c), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	-	SM25c	To assess past use, extent, and potential for containing hazardous waste and hazardous constituents.
Geophysical survey and borehole clearance	GPR and EM	Geophysical survey performed at the site located within the FBH golf course near the 10th green	To evaluate the geometry of historic sites and assess the presence of buried metal objects.
Soil-gas survey	VOCs including methane	Two soil-gas samples collected; collection of three additional samples was attempted but soil was too impermeable	To assess the extent of possible subsurface soil contamination resulting from past activities.
Soil borings and subsurface soil sampling	SVOCs, VOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters	Five borings were drilled; two samples per boring were collected for chemical analysis: one from fill and one from native material beneath fill	To assess possible presence of hazardous constituents in subsurface soil.

Landfill parameters include fluoride, nitrates, hardness, sulfate, chloride, total organic carbon, chemical oxygen demand, boron, alkalinity, total dissolved solids (TDS), pH, biochemical oxygen demand 5 (five-day test), ammonia, specific conductivity, and total phenolic compounds.

-	Not applicable
EI	Environmental investigation
EM	Electromagnetics
GPR	Ground penetrating radar
PCBs	Polychlorinated biphenyls
SVOCs	Semivolatile organic compounds
VOCs	Volatile organic compounds

Table 4.60: Summary of Metals and Cyanide Concentrations in Subsurface Soil that are Greater than Background Concentrations: EI Site SM25c

Site Identification:	SM25CSB001	SM25CSB001	SM25CSB001-DUP	SM25CSB002	SM25CSB002	SM25CSB003	SM25CSB003
Depth:	2	5.5	6	1	4.5	5.5	11.5
Sample Date:	02/09/94	02/09/94	02/09/94	02/07/94	02/07/94	02/08/94	02/08/94
Analyte (mg/kg)							
Metals							
Arsenic	ND	7.4 j	8.07 Dj	ND	ND	7.93 j	ND
Barium	ND	106	124 D	ND	ND	80.5	ND
Beryllium	ND	ND	ND	ND	ND	0.756	ND
Boron	ND	ND	ND	ND	ND	ND	15.3
Chromium	ND	ND	ND	ND	ND	ND	11
Cobalt	ND	11.5	10.9 D	ND	7	7.8	4.16
Copper	ND	ND	ND	ND	ND	29.3	15.3
Cyanide	ND	ND	ND	ND	ND	ND	ND
Iron	ND	ND	26,100 D	ND	ND	26,800	13,100
Lead	ND	23.3	ND	546	ND	52.4	ND
Manganese	ND	946	646 D	ND	ND	ND	285
Mercury	ND	ND	ND	0.274	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	34.1	15.3
Selenium	ND	ND	0.335 Drr	ND	ND	ND	ND
Sodium	ND	ND	ND	466	ND	ND	515
Thallium	ND	ND	ND	ND	ND	ND	18.6
Vanadium	ND	ND	47.2 D	ND	ND	ND	18.6
Zinc	ND	ND	79.5 D	213	ND	159	46

Table 4.60 (Continued)

Analyte (mg/kg)	Site Identification: / Depth: / Sample Date:	SM25CSB004 4.5 02/08/94	SM25CSB004 13 02/09/94	SM25CSB004 0.3 02/09/94	SM25CSB005 5.3 02/09/94
Metals					
Arsenic		6.9	ND	ND	12
Barium		ND	ND	ND	94.2
Beryllium		ND	ND	ND	ND
Boron		ND	15.1	ND	ND
Chromium		ND	6.26	ND	ND
Cobalt		ND	ND	ND	9.91
Copper		ND	ND	ND	ND
Cyanide		ND	1.16 j	ND	ND
Iron		ND	ND	ND	24,800
Lead		ND	5.51	ND	19.8
Manganese		ND	ND	ND	570
Mercury		ND	ND	ND	ND
Nickel		ND	ND	ND	ND
Selenium		ND	ND	ND	0.347 rr
Sodium		ND	475	ND	ND
Thallium		ND	ND	ND	ND
Vanadium		ND	9.83	ND	ND
Zinc		ND	ND	ND	89.2

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

D Duplicate sample analysis
EI Environmental investigation
j Value is estimated, flag applied during independent data validation
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
rr Value was found unacceptable during independent data validation

Table 4.61: Analytes Detected in Subsurface Soil: EI Site SM25c

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	SM25CSB001 2 02/09/94	SM25CSB001 5.5 02/09/94	SM25CSB001-DUP 6 02/09/94	SM25CSB002 1 02/07/94	SM25CSB002 4.5 02/07/94	SM25CSB003 5.5 02/08/94	SM25CSB003 11.5 02/08/94
VOCs							
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	0.024 Bb	0.019 Bb	ND	ND
SVOCs							
bis(2-Ethylhexyl) phthalate	2.3 Bb	0.52 Bb	2 DBb	ND	ND	0.65 Bb	0.88 Bb
Di-N-butyl phthalate	0.51 b	0.17 JPb	0.19 Db	ND	ND	ND	0.67 b
Dodecane	ND	ND	ND	ND	0.44 S	ND	ND
Eicosane	ND	ND	ND	0.4 S	0.33 S	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND
Heneicosane	ND	ND	ND	ND	0.33 S	ND	ND
Heptacosane	ND	ND	ND	0.93 S	ND	ND	ND
Heptadecane	ND	ND	ND	0.93 S	0.56 S	ND	ND
Hexadecane	ND	ND	ND	0.67 S	0.44 S	ND	ND
Nonacosane	ND	ND	ND	0.8 S	ND	ND	ND
Nonadecane	ND	ND	ND	0.93 S	0.44 S	ND	ND
Tetradecane	ND	ND	ND	ND	0.56 S	ND	ND
Tridecane	ND	ND	ND	ND	0.44 S	ND	ND
Landfill Parameters							
Ammonia	48.4	52.9	33.9 Db	166 j	ND	45.2 j	15.4 bj
Chloride*	ND	ND	ND	ND	ND	ND	ND
Fluoride*	ND	ND	6.47 Dbj	ND	ND	11.5 bj	ND
Nitrite, nitrate - nonspecific	ND	1.44 j	2.05 Dj	ND	ND	4.23 j	0.49 b
pH	ND	ND	ND	ND	8.3 rr	ND	ND
Sulfate*	ND	ND	ND	96.7	102	ND	ND
Total organic carbon	3900 j	3700 j	4900 Dj	20,000 j	23,000 j	6000 j	ND
Total recoverable phenolics*	ND	ND	ND	1.45 b	ND	ND	ND

Table 4.61 (Continued)

Site Identification: / Depth: / Sample Date: / Analyte (mg/kg)	SM25CSB004 4.5 02/08/94	SM25CSB004 13 02/09/94	SM25CSB005 0.3 02/09/94	SM25CSB005 5.3 02/09/94
VOCs				
Trichlorofluoromethane	ND	0.0086 S	ND	ND
Acetone	ND	ND	0.027	ND
SVOCs				
bis(2-Ethylhexyl) phthalate	0.53 Bb	0.49 Bb	ND	1.9 Bb
Di-N-butyl phthalate	ND	ND	ND	ND
Dodecane	ND	ND	ND	ND
Eicosane	ND	ND	ND	ND
Fluoranthene	0.17	ND	ND	ND
Heneicosane	ND	ND	ND	ND
Heptacosane	ND	ND	ND	ND
Heptadecane	ND	ND	ND	ND
Hexadecane	ND	ND	ND	ND
Nonacosane	ND	ND	ND	ND
Nonadecane	ND	ND	ND	ND
Tetradecane	ND	ND	ND	ND
Tridecane	ND	ND	ND	ND
Landfill Parameters				
Ammonia	ND	ND	ND	43.4 j
Chloride*	ND	6.94 j	ND	ND
Fluoride*	ND	ND	ND	8.76 bj
Nitrite, nitrate - nonspecific	4.87 j	1.06	ND	5.03 j
pH	ND	ND	ND	ND
Sulfate*	ND	98.7 j	ND	ND
Total organic carbon	43000 j	70000 j	ND	3800 j
Total recoverable phenolics*	ND	ND	ND	ND

Table 4.61 (Continued)

b	Value is undetected because of method blank contamination; flag applied during independent data validation
B	Analyte detected in the associated method blank or quality control blank, as well as the sample; flag applied by the laboratory
D	Duplicate sample analysis
EI	Environmental investigation
j	Value is estimated, flag applied during independent data validation
mg/kg	Milligrams per kilogram
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
rr	Value was found unacceptable during independent data validation
S	Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry methods)
SVOCs	Semivolatile organic compounds
VOCs	Volatile organic compounds

* Values compared to Indiana Department of Environmental Management-provided background value.

Table 4.62: Historic Military Sites (EI Site SM25f), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	-	SM25f	To assess past use, extent, and potential for containing hazardous waste and hazardous constituents.
Geophysical survey and borehole clearance	GPR and EM	Geophysical survey performed at the site located within a paved parking lot	To evaluate the geometry of historic sites and assess the presence of buried metal objects.
Soil-gas survey	VOCs including methane	Four soil-gas samples were collected; collection of 11 additional samples was attempted but soil was too impermeable	To assess the extent of possible subsurface soil contamination resulting from past activities.
Soil borings and subsurface soil sampling	SVOCs, VOCs, total metals, pesticides/PCBs, herbicides, and landfill parameters	Three soil borings were drilled; two samples per boring were collected for chemical analysis: one from fill and one from native soil beneath fill. Three replacement borings were sampled to replace samples that arrived at laboratory above preservation temperature of 4° Celsius	To assess possible presence of hazardous constituents in subsurface soil.

Landfill parameters include fluoride, nitrates, hardness, sulfate, chloride, total organic carbon, chemical oxygen demand, boron, alkalinity, total dissolved solids (TDS), pH, biochemical oxygen demand 5 (five-day test), ammonia, specific conductivity, and total phenolic compounds.

-	Not applicable
EI	Environmental investigation
EM	Electromagnetics
GPR	Ground penetrating radar
PCBs	Polychlorinated biphenyls
SVOCs	Semivolatile organic compounds
VOCs	Volatile organic compounds

Table 4.63: Soil-Gas Analytical Results: EI Site SM25f

Sample ID	Compound Detected	Concentration Detected (μg/l)	Sampling Depth (feet)
S25F-06	TCA	0.003	5
S25F-06	PCE	0.004	5
S25F-06Rep	TCA	0.003	5
S25F-06Rep	PCE	0.004	5
S25F-08	TVHC	2.	5
S25F-12	TCE	0.006	5
S25F-12	PCE	0.004	5
S25F-12	TVHC	14	5
S25F-15	TCA	0.001	5
S25F-15	PCE	0.004	5

EI Environmental investigation
ID Identification
PCE Tetrachloroethene
Rep Replicate sample
TCA 1,1,1-Trichloroethane
TCE Trichloroethene
TVHC Total volatile hydrocarbons
μg/l Micrograms per liter

Table 4.64: Summary of Metals Concentrations in Subsurface Soil that are Greater than Background Concentrations: EI Site SM25f

Analyte (mg/kg)	Site Identification: / Depth: / Sample Date:	SM25FSB01A 2 02/07/94	SM25FSB01A 7.5 02/07/94	SM25FSB02A 2.5 02/07/94	SM25FSB02A 6.5 02/07/94	SM25FSB03A 3 02/07/94	SM25FSB03A 6.5 02/07/94
Metals							
Arsenic		ND	ND	ND	5.67 j	ND	ND
Barium		ND	58.6	148	ND	ND	ND
Cobalt		ND	ND	38.3	ND	ND	ND
Copper		ND	13.5	32.1	ND	ND	ND
Iron		ND	11300	30900	ND	ND	ND
Lead		ND	ND	ND	ND	30	ND
Manganese		ND	530	1240	ND	ND	ND
Nickel		ND	ND	38.3	ND	ND	ND
Sodium		447	ND	544	ND	ND	ND
Vanadium		ND	18	56.9	ND	ND	ND
Zinc		ND	39.5	89	ND	107	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI — Environmental investigation
j — Value is estimated, flag applied during independent data validation
mg/kg — Milligrams per kilogram
ND — Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.65: Summary of Analytes Detected In Subsurface Soil: EI Site SM25f

Analyte (mg/kg)	Site Identification: Depth: Sample Date:	SM25FSB01A 2 02/07/94	SM25FSB01A 7.5 02/07/94	SM25FSB02A 2.5 02/07/94	SM25FSB02A 6.5 02/07/94	SM25FSB03A 3 02/07/94	SM25FSB03A 6.5 02/07/94
VOCs							
Acetone		ND	0.011 JPb	0.026 Bb	ND	0.027 Bb	0.014 Bb
SVOCs							
Benzo[A]anthracene		ND	ND	ND	ND	0.51	ND
Benzo[a]pyrene		ND	ND	ND	ND	0.44	ND
Benzo[B]fluoranthene		ND	ND	ND	ND	0.65	ND
Benzo[K]fluoranthene		ND	ND	ND	ND	0.22	ND
bis(2-Ethylhexyl) phthalate		ND	ND	ND	ND	ND	9.1 B
Chrysene		ND	ND	ND	ND	0.6	ND
Dodecane		ND	0.34 S	ND	ND	ND	ND
Eicosane		ND	ND	ND	ND	0.35 S	ND
Fluoranthene		ND	ND	ND	ND	0.76	ND
Heptadecane		ND	ND	ND	ND	0.46 S	ND
Hexadecane		ND	ND	ND	ND	0.35 S	ND
Nonadecane		ND	ND	ND	ND	0.35 S	ND
Phenanthrene		ND	ND	ND	ND	0.25	ND
Pyrene		ND	ND	ND	ND	0.59	ND
Tetradecane		ND	ND	ND	ND	0.46 S	ND
Pesticides							
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)		ND	ND	ND	ND	0.00774 Cj	ND
2,2-bis(p-Chlorophenyl)-1,1-dichloroethane (DDD)		ND	ND	ND	ND	0.0323 Crr	ND
2,2-bis(p-Chlorophenyl)-1,1-dichloroethene (DDE)		ND	ND	ND	ND	0.0173 Crr	ND
alpha-Chlordane		ND	ND	ND	ND	0.00554 Crr	ND
gamma-Chlordane		ND	ND	ND	ND	0.00485 Cj	ND
Landfill Parameters							
Ammonia		12.6 bj	8.33 bj	61.7 j	12.2 bj	37.4 j	17.2 bj
Boron*		ND	16.9	ND	ND	ND	ND
Chloride*		ND	ND	48.8 j	50.2 j	27.6 j	6.36 b
Fluoride*		ND	4.25 b	11.9 b	2.97 b	ND	ND
Nitrite, nitrate - non-specific		0.283	ND	0.368 bj	ND	0.784 j	ND
pH		8.4 rr	8.3 rr	7.7 rr	8.2 rr	9.8 rr	8.7 rr

Table 4.65 (Continued)

Analyte (mg/kg)	Site Identification: Depth: Sample Date:	SM25FSB01A 2 02/07/94	SM25FSB01A 7.5 02/07/94	SM25FSB02A 2.5 02/07/94	SM25FSB02A 6.5 02/07/94	SM25FSB03A 3 02/07/94	SM25FSB03A 6.5 02/07/94
Landfill Parameters.(continued)							
Sulfate*		ND	ND	96.7 j	31.8 b	253 j	29.5 b
Total organic carbon		21,000 j	30,000 j	4800 j	46,000 j	48,000 j	48,000 j

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

b	Value is undetected because of method blank contamination; flag applied during independent data validation
B	Analyte detected in the associated method blank or quality control blank, as well as the sample; flag applied by the laboratory
C	Analysis was confirmed
EI	Environmental investigation
J	The value is estimated
j	Value is estimated, flag applied during independent data validation
mg/kg	Milligrams per kilogram
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
P	The value is less than the reporting limit, but greater than instrument detection limit
rr	Value was found unacceptable during independent data validation
S	Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry methods)
SVOCs	Semivolatile organic compounds
VOC	Volatile organic compounds

* Value compared to Indiana Department of Environmental Management-provided background values

Table 4.66: Historic Military Sites (EI Site SM25h), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	-	SM25h	To assess past use, extent, and potential for containing hazardous waste and hazardous constituents.
Surface soil sampling	SVOCs, total metals, pesticides/ PCBs, herbicides, and landfill parameters	Six surface soil samples collected from portion of site within wooded area, where construction debris is present, northeast of Building 518	To assess possible presence of hazardous constituents in surface soil.

Landfill parameters include fluoride, nitrates, hardness, sulfate, chloride, total organic carbon, chemical oxygen demand, boron, alkalinity, total dissolved solids (TDS), pH, biochemical oxygen demand 5 (five-day test), ammonia, specific conductivity, and total phenolic compounds.

- Not applicable
EI Environmental investigation
EM Electromagnetics
GPR Ground penetrating radar
PCBs Polychlorinated biphenyls
SVOCs Semivolatile organic compounds
VOCs Volatile organic compounds

Table 4.67: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM25h

Analyte (mg/kg)	Site Identification: Soil Association: Sample Date:	SM25HSS001 M-C 02/06/94	SM25HSS002 M-C 02/06/94	SM25HSS003 M-C 02/06/94	SM25HSS004 M-C 02/06/94	SM25HSS005 M-C 02/06/94	SM25HSS006 M-C 02/06/94
Metals							
Barium		ND	ND	ND	ND	126	ND
Cadmium		0.874	ND	ND	ND	ND	ND
Chromium		17.8	18.5	ND	ND	22.1	ND
Cobalt		8.58	ND	ND	ND	9.32	ND
Copper		25.9	ND	ND	ND	37.9	ND
Iron		21000	ND	ND	ND	26900	ND
Lead		87.4	75.7	41.2	53.2	96.4	76.9
Mercury		ND	ND	ND	ND	0.314	0.226
Nickel		24.3	ND	ND	ND	26.9	ND
Sodium		566	634	ND	549	585	ND
Vanadium		ND	ND	ND	ND	36.3	ND
Zinc		178	111	ND	133	237	109

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.68: Summary of Analytes Detected in Surface Soil: EI Site SM25h

Analyte (mg/kg) / Site Identification: Soil Association: Sample Date:	SM25HSS001 M-C 02/06/94	SM25HSS002 M-C 02/06/94	SM25HSS003 M-C 02/06/94	SM25HSS004 M-C 02/06/94	SM25HSS005 M-C 02/06/94	SM25HSS006 M-C 02/06/94
SVOCs						
2-Methylnaphthalene	ND	ND	2	ND	ND	ND
2-Methylpyrene	ND	ND	3 S	ND	ND	ND
2-Phenylnaphthalene	ND	ND	4 S	ND	ND	ND
Acenaphthene	ND	3	6	ND	ND	ND
Anthracene	ND	6	7	ND	ND	ND
Benzo[a]anthracene	ND	10	20	0.58	0.76	ND
Benzo[a]pyrene	ND	10	20	0.58	0.76	ND
Benzo[b]fluoranthene	ND	20	20	0.73	1.1	0.25
Benzo[b]fluorene	ND	ND	4 S	ND	ND	ND
Benzo[e]pyrene	ND	8 S	10 S	ND	0.47 S	ND
Benzo[g,h,i]perylene	ND	6	ND	0.33	0.52	ND
Benzo[k]fluoranthene	ND	6	10	0.32	0.41	ND
bis(2-Ethylhexyl) phthalate	1.8 Bb	10 B	ND	ND	ND	ND
Carbazole	ND	3	5	ND	ND	ND
Chrysene	ND	20	20	0.7	0.96	ND
Di-N-butyl phthalate	0.4	ND	ND	ND	ND	ND
Dibenzo[a,h]anthracene	ND	ND	3	ND	ND	ND
Dibenzofuran	ND	ND	5	ND	ND	ND
Fluoranthene	ND	30	40	1.2	1.6	0.4
Fluorene	ND	3	7	ND	ND	ND
Heptacosane	ND	ND	ND	ND	ND	1.5 S
Heptadecane	0.49 S	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	ND	8	10	0.38	0.55	ND
Naphthalene	ND	ND	3	ND	ND	ND
Nonacosane	1.6 S	ND	4 S	ND	ND	ND
Palmitic acid/hexadecanoic acid	ND	ND	ND	0.67 S	ND	0.5 S
Phenanthrene	ND	30	40	0.77	0.85	ND
Pyrene	ND	30	40	1	1.4	0.35
r-Sitosterol/(3B,24s)-stigmast-5-en-3-ol/clionaste	ND	ND	ND	ND	1.3 S	1.7 S
Pesticides						
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	0.00599 Cj	0.102 Cj	ND	ND	0.0112 Cj	ND
2,2-bis(p-Chlorophenyl)-1,1-dichloroethene (DDE)	ND	0.0128 Cj	ND	ND	0.0155 Cj	ND

Table 4.68 (Continued)

Analyte (mg/kg)	Site Identification: Soil Association: Sample Date:	SM25HSS001 M-C 02/06/94	SM25HSS002 M-C 02/06/94	SM25HSS003 M-C 02/06/94	SM25HSS004 M-C 02/06/94	SM25HSS005 M-C 02/06/94	SM25HSS006 M-C 02/06/94
gamma-Chlordane		ND	0.00711 Cbj	ND	ND	ND	ND
Landfill Parameters							
Ammonia		325	326	295	316	199	366
Chloride		31.7	ND	ND	ND	9.24	ND
Nitrite, nitrate - nonspecific		2.88	10.3	3.27	3.33	3.97	3.49
pH		8 rr	8 rr	7.8 rr	7.6 rr	7.8 rr	7.8 rr
Sulfate		160	ND	ND	94.2	ND	ND
Total organic carbon		37,000 j	51,000 j	20,000 j	53,000 j	51,000 j	62,000 j
Total recoverable phenolics		1.96 b	5.08	2.6	3.59	ND	6.79

b Value is undetected because of method blank contamination; flag applied during independent data validation
B Analyte detected in the associated method blank or quality control blank as well as the sample; flag applied by laboratory
C Analysis was confirmed
EI Environmental investigation
j Value is estimated, flag added during independent data validation
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
rr Value was found unacceptable during independent data validation
S Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry method)
SVOCs Semivolatile organic compounds

Table 4.69: Historic Military Sites (EI Site SM25i), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	---	SM25i	To assess past use, extent, and potential for containing hazardous waste and hazardous constituents.
Geophysical survey	GPR and EM	Geophysical survey performed over site located in a mowed grass field.	To evaluate the geometry of historic sites and assess the presence of buried metal objects.
Test soil boring	---	One test boring was hand augered near the center of the site to a depth of 5 feet.	To assess possible presence of subsurface debris.
Surface soil sampling	SVOCs, total metals, pesticides/ PCBs, herbicides, and landfill parameters	Six surface soil samples collected.	To assess possible presence of hazardous constituents in subsurface soil.

Landfill parameters include fluoride, nitrates, hardness, sulfate, chloride, total organic carbon, chemical oxygen demand, boron, alkalinity, total dissolved solids (TDS), pH, biochemical oxygen demand 5 (five-day test), ammonia, specific conductivity, and total phenolic compounds.

--- Not applicable
EI Environmental investigation
EM Electromagnetics
GPR Ground penetrating radar
PCBs Polychlorinated biphenyls
SVOCs Semivolatile organic compounds
VOCs Volatile organic compounds

Table 4.70: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM25I

Analyte (mg/kg)	Site Identification: Soil Association: Sample Date:	SM25ISS001 M-C 02/07/94	SM25ISS002 M-C 02/07/94	SM25ISS003 M-C 02/07/94	SM25ISS004 M-C 02/07/94	SM25ISS005 M-C 02/07/94	SM25ISS006 M-C 02/07/94
Metals							
Cobalt		ND	ND	ND	ND	9.14	ND
Sodium		ND	496	ND	ND	ND	ND
Zinc		ND	ND	78.5	ND	ND	ND

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.71: Summary of Analytes Detected in Surface Soil: EI Site SM25I

Analyte (mg/kg) — Site Identification: / Soil Association: / Sample Date:	SM25ISS001 M-C 02/07/94	SM25ISS002 M-C 02/07/94	SM25ISS003 M-C 02/07/94	SM25ISS004 M-C 02/07/94	SM25ISS005 M-C 02/07/94	SM25ISS006 M-C 02/07/94
SVOCs						
Acenaphthylene	0.64	ND	ND	ND	ND	ND
Benzo[a]anthracene	0.31	ND	ND	ND	ND	ND
Benzo[a]pyrene	0.72	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	0.72	ND	ND	ND	ND	ND
Benzo[e]pyrene	0.57 S	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	1.3	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	0.29	ND	ND	ND	ND	ND
bis(2-Ethylhexyl) phthalate	3.2 Bb	0.36 Bb	0.62 Bb	ND	0.27 Bb	ND
Chrysene	0.46	ND	ND	ND	ND	ND
Di-n-butyl phthalate	0.29 b	0.47 b	0.27 b	ND	0.5 b	0.2 JPb
Fluoranthene	0.43	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	0.69	ND	ND	ND	ND	ND
Nonacosane	0.46 S	0.99 S	0.45 S	0.66 S	0.83 S	1.4 S
Pyrene	0.98	ND	ND	ND	ND	ND
r-Sitosterol/(3B,24s)-stigmast-5-en-3-ol/clionaste	0.92 S	ND	ND	ND	ND	ND
Pesticides						
2,2-bis (p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	0.0721 Crr	0.0261 Cj	0.0168 Cj	0.0279 Cj	0.00698 Cj	0.00478 Cj
2,2-bis (p-Chlorophenyl)-1,1-dichloroethane (DDD)	0.0755 Cj	0.0161 Crr	ND	ND	ND	0.00829 Crr
2,2-bis (p-Chlorophenyl)-1,1-dichloroethene (DDE)	0.0755 Cj	0.062 C	0.0437 C	0.0745 C	0.00814 C	0.00829 C
Landfill Parameters						
Chloride	ND	ND	ND	ND	ND	7.12 bj
pH	8 rr	7.8 rr	8.1 rr	6.2 rr	6.6 rr	7.4 rr
Total organic carbon	58,000 j	56,000 j	50,000 j	28,000 j	34,000 j	32,000 j
Total recoverable phenolics	4.27	2.89 b	1.14 b	1.53 b	1.69 b	2.96 b
Nitrate/nitrite-nonspecific	6.74 j	6.03 j	3.15 j	3.28 j	3.42 j	4.47 j
Ammonia	86 j	234 j	184 j	205 j	320 j	201 j

Table 4.71 (continued)

C	Analysis was confirmed
EI	Environmental investigation
j	Value is estimated, flag added during independent data validation
M-C	Miami-Crosby soil association
mg/kg	Milligrams per kilogram
ND	Analyte not detected, or not detected at concentration exceeding background concentrations
rr	Value was found unacceptable during independent data validation
S	Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry method)
SVOCs	Semivolatile organic compounds

Table 4.72: Historic Military Sites (EI Site SM25j), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	-	SM25j	To assess past use, extent, and potential for containing hazardous waste and hazardous constituents.
Geophysical survey	GPR and EM	Geophysical survey performed over site located in mowed grass field	To evaluate the geometry of historic sites and assess the presence of buried metal objects.
Test soil boring	-	One test boring was hand augered near the center of the site to a depth of 5 feet	To assess possible presence of subsurface debris.
Surface soil sampling	SVOCs, total metals, pesticides/ PCBs, herbicides, and landfill parameters	Six surface soil samples collected	To assess possible presence of hazardous constituents in subsurface soil.

Landfill parameters include fluoride, nitrates, hardness, sulfate, chloride, total organic carbon, chemical oxygen demand, boron, alkalinity, total dissolved solids (TDS), pH, biochemical oxygen demand 5 (five-day test), ammonia, specific conductivity, and total phenolic compounds.

- Not applicable
EI Environmental investigation
EM Electromagnetics
GPR Ground penetrating radar
PCBs Polychlorinated biphenyls
SVOCs Semivolatile organic compounds

Table 4.73: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM25j

Site Identification:	SM25JSS001	SM25JSS001-DUP	SM25JSS002	SM25JSS003	SM25JSS004	SM25JSS005	SM25JSS006
Soil Association:	M-C	M-C	M-C	M-C	M-C	M-C	M-C
Sample Date:	02/07/94	02/07/94	02/07/94	02/07/94	02/07/94	02/07/94	02/07/94
Analyte (mg/kg)							
Metals							
Chromium	ND	ND	ND	ND	ND	17.5	ND
Cobalt	ND	ND	ND	13.3	ND	9.73	ND
Copper	ND	ND	ND	ND	54	23.7	31.4
Iron	ND	ND	ND	ND	ND	21,200	ND
Lead	ND	ND	ND	ND	97.2	ND	47.7
Manganese	ND	ND	ND	ND	ND	935	ND
Nickel	ND	ND	ND	ND	ND	22.4	ND
Zinc	ND	ND	ND	ND	103	76.1	82.9

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI Environmental investigation
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.74: Summary of Analyte Concentrations Detected In Surface Soil: EI Site SM25j

Site Identification: / Soil Association: / Sample Date: / Analyte (mg/kg)	SM25JSS001 M-C 02/07/94	SM25JSS001-DUP M-C 02/07/94	SM25JSS002 M-C 02/07/94	SM25JSS003 M-C 02/07/94	SM25JSS004 M-C 02/07/94	SM25JSS005 M-C 02/07/94	SM25JSS006 M-C 02/07/94
SVOCs							
Anthracene	ND	ND	ND	ND	0.59	ND	ND
Benzo[a]anthracene	ND	ND	ND	ND	2.2	0.25	0.26
Benzo[a]pyrene	ND	ND	ND	ND	2.2	0.26	0.28
Benzo[b]fluoranthene	ND	ND	ND	0.2	2.8	0.36	0.38
Benzo[g,h,i]perylene	ND	ND	ND	ND	ND	ND	0.21
Benzo[k]fluoranthene	ND	ND	ND	ND	1.2	ND	ND
bis(2-Ethylhexyl) phthalate	0.29 Bb	0.81 DBb	0.38 Bb	0.39 Bb	0.26 Bb	0.4 Bb	0.49 Bb
Carbazole	ND	ND	ND	ND	0.24	ND	ND
Chrysene	ND	ND	ND	ND	2.7	0.35	0.34
di-n-butyl phthalate	0.35 b	0.22 DBb	0.28 b	ND	ND	ND	ND
Dibenzo[a,h]anthracene	ND	ND	ND	ND	0.4	ND	ND
Fluoranthene	ND	ND	ND	0.24	4.6	0.49	0.55
Fluorene	ND	ND	ND	ND	0.22	ND	ND
Heptacosane	ND	ND	ND	ND	ND	0.37 S	ND
Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	1.6	0.19 JP	0.23
Nonacosane	0.41 S	ND	1.4 S	ND	ND	0.5 S	0.5 S
Palmitic acid/hexadecanoic acid	ND	ND	ND	0.4 S	0.81 S	ND	ND
Phenanthrene	ND	ND	ND	ND	2.7	0.31	0.28
Pyrene	ND	ND	ND	0.24	3.9	0.45	0.48
r-Sitosterol/(3B,24s)-stigmast-5-en-3-ol/clionaste	0.79 S	ND	ND	ND	ND	ND	ND
Pesticides							
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane (DDT)	ND	ND	ND	ND	0.27 C	0.0175 C	ND
2,2-bis(p-Chlorophenyl)-1,1-dichloroethane (DDD)	ND	ND	ND	ND	0.13 C	0.0162 C	ND
2,2-bis(p-Chlorophenyl)-1,1-dichloroethene (DDE)	ND	ND	ND	ND	0.27 C	0.0175 C	ND
Landfill Parameters							
Chloride	ND	ND	ND	ND	8.95 j	ND	ND
Fluoride	ND	ND	ND	ND	4.3 bj	ND	ND
Nitrite, nitrate - nonspecific	8.55 J	13.1 D	10.9	12.7	6.11	9.71	10.7
pH	7.2 rr	7.3 Drr	6.9 rr	6.9 rr	7.6 rr	7.7 rr	7.7 rr
Total organic carbon	32,000 j	30,000 Dj	31,000 j	32,000 j	31,000 j	40,000 j	29,000 j

Table 4.74 (continued)

Analyte (mg/kg)	Site Identification:	SM25JSS001	SM25JSS001-DUP	SM25JSS002	SM25JSS003	SM25JSS004	SM25JSS005	SM25JSS006
	Soil Association:	M-C	M-C	M-C	M-C	M-C	M-C	M-C
	Sample Date:	02/07/94	02/07/94	02/07/94	02/07/94	02/07/94	02/07/94	02/07/94
Total recoverable phenolics		4.32	1.94 Db	4.46 b	8.02	ND	ND	ND
Ammonia		295 j	272 D	288	265	161	227	173

b Value is undetected because of method blank contamination; flag applied during independent data validation
B Analyte detected in the associated method blank or quality control blank as well as the sample; flag applied by laboratory
C Analysis was confirmed
D Duplicate sample analysis
EI Environmental investigation
j Value is estimated; qualifier applied during independent data validation
J The value is estimated
M-C Miami-Crosby soil association
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
P The value is less than the reporting limit, but greater than the instrument detection limit
rr Value was found unacceptable during independent data validation
S Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry method)
SVOCs Semivolatile organic compounds

Table 4.75: Historic Military Sites (EI Site SM25k), Summary of Phase I Sampling Activities

Activity	Analytes	Locations	Intended Objective
Records review	-	SM25k	To assess past use, extent, and potential for containing hazardous waste and hazardous constituents.
Surface soil sampling	SVOCs, total metals, pesticides/ PCBs, herbicides, and landfill parameters	Six surface soil samples collected where surface debris was visible	To assess possible presence of hazardous constituents in sub-surface soil.

Landfill parameters include fluoride, nitrates, hardness, sulfate, chloride, total organic carbon, chemical oxygen demand, boron, alkalinity, total dissolved solids (TDS), pH, biochemical oxygen demand 5 (five-day test), ammonia, specific conductivity, and total phenolic compounds.

-	Not applicable
EI	Environmental investigation
PCBs	Polychlorinated biphenyls
SVOCs	Semivolatile organic compounds

Table 4.76: Summary of Metals Concentrations in Surface Soil that are Greater than Background Concentrations: EI Site SM25k

Site Identification:	SM25KSS001	SM25KSS002	SM25KSS003	SM25KSS004	SM25KSS005	SM25KSS006
Soil Association:	G-S	G-S	G-S	G-S	G-S	G-S
Sample Date:	02/22/94	02/22/94	02/22/94	02/22/94	02/22/94	02/22/94
Analyte (mg/kg)						
Metals						
Arsenic	9.1	7.8	ND	11	8	9.2
Barium	102	ND	ND	ND	ND	96.8
Cadmium	ND	ND	ND	ND	1.47	ND
Chromium	21.3	ND	ND	ND	20.1	18.4
Copper	22.8	ND	21.1	30.9	ND	23
Iron	22,800	19,500	ND	40,300	ND	20,000
Lead	38	ND	40.7	44.4	46.9	ND
Manganese	ND	ND	ND	793	ND	ND
Nickel	22.8	ND	ND	24.2	ND	21.5
Sodium	578	468	492	511	576	522
Thallium	21.3	15.6	19.7	45.7	13.4 JP	18.4
Vanadium	39.5	32.5	ND	ND	ND	35.3
Zinc	319	182	111	134	469	92.2

Analytical results for aluminum, calcium, magnesium, and potassium are included in the data summary, Appendix C.

EI	Environmental investigation
G-S	Genesee-Sloan soil association
j	Value is estimated, flag added during independent data validation
JP	Analyte concentration is estimated; analyte reported at concentration less than reporting limit; flags applied by laboratory
/I	The low-spike recovery is high; qualifier applied during Army data review
mg/kg	Milligrams per kilogram
ND	Analyte not detected, or not detected at concentration exceeding background concentrations

Table 4.77: Summary of Analytes Detected in Surface Soil: EI Site SM25k

Site Identification: / Soil Association: / Sample Date: / Analyte (mg/kg)	SM25KSS001 G-S 02/22/94	SM25KSS002 G-S 02/22/94	SM25KSS003 G-S 02/22/94	SM25KSS004 G-S 02/22/94	SM25KSS005 G-S 02/22/94	SM25KSS006 G-S 02/22/94
SVOCs						
1,2-Epoxycyclohexene	ND	0.39 S	ND	ND	ND	ND
bis (2-Ethylhexyl) phthalate	0.3	ND	ND	0.24	ND	ND
Heptacosane	1.2 S	0.78 S	0.84 S	0.81 S	0.54 S	0.61 S
Nonacosane	3 S	2.6 S	2.8 S	4 S	1.3 S	1.5 S
Pentacosane	0.61 S	0.39 S	0.42 S	0.54 S	ND	ND
r-Sitosterol/(3B,24s)-stigmast-5-en-3-ol/ clionaste	1.2 S	0.65 S	0.7 S	0.81 S	0.67 S	0.61 S
Herbicide						
2,4-D/2,4-Dichlorophenoxyacetic acid	0.0228 C	ND	ND	ND	ND	ND
Landfill Parameters						
Ammonia	280/I	227/I	324/I	312/I	262/I	352/I
Nitrite, nitrate - nonspecific	4.33 j	4.91 j	13.2 j	12.7 j	9.21 j	11.6 j
pH	7.5 j	7.6 j	7.6 j	7.6 j	7.6 j	7.5 j
Total organic carbon	43,000 j	32,000 j	45,000 j	35,000 j	48,000 j	40,000 j
Total recoverable phenolics	ND	ND	2.18	ND	ND	1.57

C Analysis was confirmed
EI Environmental investigation
G-S Genesee-Sloan soil association
j Value is estimated, flag added during independent data validation
/I The low-spike recovery is high; qualifier applied during Army data review
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
S Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry method)

Table 4.78: Former Sewage Treatment Plant, West of Building 674
Summary of Phase I Activities: EI Site SM26

Activity	Method	Locations	Intended Objective
Surface geophysical survey	EM/GPR and M-Scope	South of Shafer Road, West of Building 674	To locate and delineate boundaries of the former sewage treatment plant.

EI Environmental investigation
EM Electromagnetic
GPR Ground penetrating radar

Table 4.79: Former Sewage Treatment Plant, North of Building 509
Summary of Phase I Activities: EI Site SM27

Activity	Method	Locations	Intended Objective
Surface geophysical survey	EM/GPR	Area north of Building 509	To locate and delineate boundaries of the former sewage treatment plant.

EI Environmental investigation
EM Electromagnetic
GPR Ground penetrating radar

Table 4.80: Summary of Wash Racks, Grease Racks, and Oil/Water Separators at Fort Benjamin Harrison: EI Site SM28

Building Number	Name	Description/ Location	Point of Discharge	Construction, Use, and Maintenance
4*	Electrical Shop	Floor drains & O/W separator/ Indoor	O/W separator to ST	• Bldg. 4 was the former generator plant and diesel oil storage facility from 1972-1984. • Renovated in 1984 for use as an electrical shop. • An O/W separator located in the SW corner of the building served as an overflow pit for the generators. The floating product in the separator emptied into USTs, west of the building, which were pumped out by a contractor. • The floor drains in the building have been used to catch water spills from washing the floor and drain into the O/W separator, which has not been in service since 1984. A sump pump was installed in the separator, for emergency use only, to pump the water to the ST.
33*	PX Gasoline Station	Floor drains/ Indoor	Floor drains to O/W separator to POTW	• The garage to the gas station has 2 floor drains. • The garage does automobile repair including oil changes, tire and battery replacement and service, brake repair, parts cleaning and degreasing, and engine tune-ups. • All oils and solvents used are containerized and taken offsite by a contractor. Any water/fluid spilled on the building's floor flows into the floor drains which discharge to an O/W separator outside, behind the building. The floating product in the separator flows into a UST while the water discharges to the POTW. The UST is pumped out at least twice a year by ARA Services.
34*	Motor Pool Storage Shed	Floor drains/ Indoor	No utility connections	• 10'x10'x12' wooden storage shed has a 2'x2' catch basin in the center of floor. • This building was used to house waste oil at one time. • Any oil spills inside shed were containerized in the basin since there were no utility connections to an O/W separator or a sewer.
36	DIO Transportation Motor Pool	Wash rack/ Outdoor	Drains to ST	• 6'x12' concrete-lined curbed area with catch basin constructed to catch stormwater in a low-lying area near the building. This area is not used for vehicle washing. • The catch basin drains directly into the ST. • The wash rack was not in use at the time of the Weston site visit, October 1991.

Table 4.80 (Continued)

Building Number	Name	Description/ Location	Point of Discharge	Construction, Use, and Maintenance
36*	DIO Transportation Motor Pool	O/W separator/ Indoor	Drains to POTW	• Motor pool was converted to supply warehouse within the last 2 to 3 years. • Some vehicle maintenance still performed at the east end of the building. All oil is collected and disposed of in a grease pit. • O/W separator located in the center of the building, flush with the floor, and no longer in use. Water drained to the POTW when in operation. • Two former pit areas backfilled with concrete a few years ago were visible. Stairwells led to basement area below so that vehicle repair and oil changes could be done on cars above.
109*	36th Engineer	Wash rack/ Indoor	Drains to POTW	• Building was an old laundry facility before being converted to a bowling alley, and then a maintenance area for the 36th Engineer Division. The building was leveled to the floor after the Gulf War since it was unsafe for occupancy. No longer in use. • Two floor drains identified; a maintenance pit backfilled with concrete is present in the center of the floor, used for organizational-level vehicle and equipment maintenance/repair.
109	36th Engineer	Grease rack/ Outdoor	Ground Surface	• Metal-lined grease racks supported vehicles for oil changes, tire and battery replacement and servicing. The racks were dismantled after the Gulf War. No longer in use. • Signs of oil staining found on ground surface. • The grease rack was not in use at the time of the Weston site visit, October 1991.
116*	Hazardous Materials Fire Department No. 2	Floor drain/ Indoor	Drains to POTW	• Floor drain in the north bay of Station No. 2 used for personal vehicle washing. • Drain discharges to catch basin outside of building, then to the POTW. • Concrete-backfilled maintenance pit inside the building.
117	Storage Shed	No drains or racks identified	-	-

Table 4.80 (Continued)

Building Number	Name	Description/ Location	Point of Discharge	Construction, Use, and Maintenance
127	U.S. Army Reserve Command	Wash rack/ Outdoor	O/W Separator to POTW	• Concrete-lined curbed wash rack with drain in center. • Wash rack used to wash out kitchen garbage cans. • All grease collected in the kitchen and emptied into the grease pit near the dumpsters. Washwater drains through an O/W separator just north of the wash rack then to the POTW. The separator is pumped out by a contractor. • The wash rack was in use at the time of the Weston site visit, October 1991.
127	U.S. Army Reserve Command	Wash rack and floor drains/ Indoor	O/W Separator to POTW	• Concrete floor sloped to center floor drain. Floor drain also present by garage door. • The east bay of the building performs organizational-level vehicle and equipment repair including oil changes, tire and battery replacement and servicing, brake repair, parts cleaning and degreasing, and engine tune-ups. • Water drains to O/W separator east of the building. Floating product flows into UST and is pumped out by contractor. The water discharges to the POTW. • The wash rack was in use at the time of the Weston site visit, October 1991.
127	U.S. Army Reserve Command	Wash rack/ Outdoor	O/W Separator to POTW	• The curbed, concrete-lined area is used for service vehicle washing. • The catch basin in the center of the wash rack drains into the O/W separator NW of the wash rack. • The wash rack was in use at the time of the Weston site visit, October 1991.
127	U.S. Army Reserve Command	Grease rack/ Outdoor	O/W Separator to POTW	• Concrete grease rack used for parts cleaning and degreasing. • Oils and solvents not already containerized run off into the catch basin below the grease rack. The catch basin drains to the O/W separator (the same separator as for the outdoor wash rack). • The floating product flows into a UST which is pumped out by a contractor and the water discharges to the POTW. • The grease rack was in use at the time of the Weston site visit, October 1991.

Table 4.80 (Continued)

Building Number	Name	Description/ Location	Point of Discharge	Construction, Use, and Maintenance
410*	Food Services	O/W separator/ Outdoor	O/W Separator to POTW	• All grease was collected in the kitchen and emptied into the grease pit behind the building. • The floating product in the separator is pumped out by a contractor while the water discharges to the POTW.
422	Roads and Grounds	Wash rack/ Outdoor	O/W Separator to POTW	• Concrete-lined curbed wash rack with drain in center. • Wash rack used for washing utility and personal vehicles and lawn maintenance equipment. • Drains to O/W separator, which discharges to the POTW. • The wash rack was in use at the time of the Weston site visit, October 1991.
422*	Roads and Grounds	Floor drains/ Indoor	O/W Separator to POTW	• Concrete floor with floor drains down center of building, in battery room and in equipment repair area. • Building services passenger and utility vehicles and lawn maintenance equipment including oil changing, solvent degreasing of parts, tire and battery replacement and servicing, limited transmission servicing, electrical system repair, engine tune-ups, and brake repair. • Floor drain in battery room (NW corner of building) drained into the first of three floor drains down the center of the building. These discharged to the O/W separator. • The 2'x2' catch basin located in the equipment repair area (NE corner of building) had a thick, oily sheen on top of water. This basin also drains to the O/W separator.
423	Car Wash	Wash rack/ Indoor	Drains to POTW	• Automatic car wash in building in past. Building now services vehicles including window and parts replacement. • Catch basins in center of floor discharged to POTW; no O/W separator present. • The wash rack was in use at the time of the Weston site visit, October 1991.

Table 4.80 (Continued)

Building Number	Name	Description/ Location	Point of Discharge	Construction, Use, and Maintenance
424	Typewriter Repair	Wash rack/ Indoor	Drains to POTW	• Three floor drains down center of floor and a 2'x2' catch basin near the heavy machinery repair shop. • East end of building repairs and stores office equipment (typewriters, calculators, etc.). The middle section of the building is used for small equipment repair and storage. • The west end of the building is for repair and storage of small equipment to heavy machinery. • Catch basin near heavy machinery shop used to be pumped out occasionally until the sewer system was revamped and allows the basin to discharge to the POTW without an O/W separator. • The wash rack was not in use at the time of the Weston site visit, October 1991.
424*	Typewriter Repair	Wash sinks/ Indoor	Pumped out	• Typewriter and small equipment cleaning room has 2 wash sinks for solvent degreasing of parts. • The fumes are vented outside. • The solvent in the 2 sinks is pumped out by Safety-Kleen every 6 weeks. Nothing discharges down the drains.
425/426	Brick-lined outdoor wash rack	Wash rack/ Outdoor	Drains to ST	• Outdoor wash rack used for vehicle washing, which is no longer in use. • Catch basin in center of wash rack drained to the ST prior to being backfilled with soil and gravel. • The wash rack was not in use at the time of the Weston site visit, October 1991.
500	Officers Club	Wash rack/ Outdoor	Drains to POTW	• Concrete-lined, curbed wash rack. • The wash rack is used to wash out the kitchen garbage cans. The water drains to the POTW; no O/W separator was visible. • The wash rack was in use at the time of the Weston site visit, October 1991. • A grease pit is located in the basement below the kitchen and is pumped out once per month by Roto Rooter.

Table 4.80 (Continued)

Building Number	Name	Description/ Location	Point of Discharge	Construction, Use, and Maintenance
515	Sanitary Maintenance Shop	Wash rack/ Outdoor	O/W Separator to POTW	• Concrete-lined, curbed wash rack used to steam clean the Dipsy dump trucks (long, rectangular, steel containers used for garbage collection). No longer in use. • The wash rack drains into the O/W separator (SE of the wash rack) and then to Bldg. 517, which is a lift station for the POTW. The FBH POTW ties into the city sanitary sewer system. • The wash rack was not in use at the time of the Weston site visit, October 1991.
536	DEH Waterworks and Refuse	Wash rack/ Outdoor	Unknown	• The exact location of this building is unknown. • Site personnel believe 536 might be an old pump house in the well field NE of Lee Rd. • The pump house was leveled to the foundation, approximately 1962-63, and backfilled with concrete, soil, and tree branches. • The exact location of the outdoor wash rack, if it once existed, is unknown. • In addition, further research must be performed to determine the exact location of Bldg. 536, if it is not the old pump house. • The wash rack was not in use at the time of the Weston site visit, October 1991.
605*	DIS Entomology	Wash rack/ Outdoor	Pumped out and sent to DRMO	• Concrete-lined curbed area outside Bldg. 605 is used as a secondary containment in case of pesticide/herbicide spills. • Any spills collected in the catch basin are pumped out, containerized, labeled by chemical, and sent to the DRMO.
669*	Former NCO Club	O/W separator/ Outdoor	O/W Separator to POTW	• The floating product in the separator was pumped out by a contractor while the water discharged to the POTW. • Building 669 was vacant at the time of records review; kitchen services no longer in use.

Table 4.80 (Continued)

Building Number	Name	Description/ Location	Point of Discharge	Construction, Use, and Maintenance
705	Auto Craft Shop	Wash racks, floor drains and O/W separator/ Indoor	O/W Separator to POTW	• Wash rack located in the NE bay is used for vehicle washing only; no maintenance is performed there. Water drains to O/W separator, located in the NE corner of the east bay. • The floor drains in the east bay drain any spills on the floor, that are not drummed in the POL Storage area, to the O/W separator. • The floating product in the separator flows into a UST, which is pumped out 4 times a year by Roto Rooter. The water then discharges to the POTW. • The wash rack was in use at the time of the Weston site visit, October 1991.

DIO Directorate of Industrial Operations
DIS Directorate of Installation Support
DRMO Defense Reutilization and Marketing Office
EI Environmental investigation
O/W Oil/water
POTW Publicly Owned Treatment Works
ST Storm sewer system
UST Underground storage tank

* Site not identified in the Enhanced Preliminary Assessment (Weston, 1992)

Table 4.81: Patriotic Site Summary of Phase I, Stage 1 Sampling Activities: EI Site SM29

Activity	Analytes	Locations	Intended Objective
Test pit evacuation and subsurface soil sampling	VOCs and SVOCs	Two subsurface soil samples collected from base of test pit for chemical analysis	To assess possible presence of POL in subsurface soil.

EI Environmental investigation
POL Petroleum, oils and lubricants
SVOCs Semivolatile organic compounds
VOCs Volatile organic compounds

Table 4.82: Summary of Analytes Detected in Subsurface Soil: EI Site SM29

Site Identification:	SM029TP001	SM029TP002
Depth:	2	2
Sample Date:	02/10/94	02/10/94
Analyte (mg/kg)		
SVOCs		
1-Ethyl-3-methylbenzene	0.42 S	ND
2-Methylnaphthalene	0.24	ND
4-Methylphenol	1	0.5
Benzoic acid	ND	0.32 JP
bis(2-ethylhexyl)phthalate	0.49 Bb	ND
Decane	0.84 S	ND
Hendecane	1.3 S	ND
Heptacosane	ND	0.42 S
Nonacosane	0.7 S	1.4 S
Palmitic acid/hexadecanoic acid	ND	1.1 S
r-Sitosterol/(3B,24s)-stigmast-5-en-3-ol/clionaste	ND	1.2 S
Tetradecane	0.84 S	ND
Tridecane	1.1 S	ND

B Analyte detected in associated method blank or quality control blank as well as the sample; flag applied by laboratory
b Value is undetected because of method blank contamination; flag applied during independent data validation
EI Environmental investigation
J The value is estimated
mg/kg Milligrams per kilogram
ND Analyte not detected, or not detected at concentration exceeding background concentrations
P Value is less than reporting limit but greater than instrument detection limit
S Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry method)
SVOCs Semivolatile organic compounds

Table 4.83: Explanation of Analyte Test Names, Flags, and Qualifiers

Explanation of Test Names and Analytes

Test Name	Analyte
111TCE	1,1,1-Trichloroethane
112TCE	1,1,2-Trichloroethane
113MCH	1,1,3-Trimethylcyclohexane
11DCE	1,1-Dichloroethene
11DCLE	1,1-Dichloroethane
124MCH	1,2,4-Trimethylcyclohexane
124TCB	1,2,4-Trichlorobenzene
124TMB	1,2,4-Trimethylbenzene
12DCE	1,2-Dichloroethenes (cis & trans)
12DCLB	1,2-Dichlorobenzene
12DCLE	1,2-Dichloroethane
12DCLP	1,2-Dichloropropane
12EPCH	1,2-Epoxycyclohexene
135TMB	1,3,5-Trimethylbenzene
13DCLB	1,3-Dichlorobenzene
13DNAP	1,3-Dimethylnaphthalene
14DCLB	1,4-Dichlorobenzene
16DNAP	1,6-Dimethylnaphthalene
1E2MB	1-Ethyl-2-methylbenzene
1MFLRE	1-Methyl-9H-fluorene
1MNAP	1-Methylnaphthalene
1MPYR	1-Methylpyrene
234HXF	2,3,4,6,7,8-Hexachlorodibenzofuran
234PCF	2,3,4,7,8-Pentachlorodibenzofuran
23DNAP	2,3-Dimethylnaphthalene
245T	(2,4,5-Trichlorophenoxy)aceticacid/Trioxone/Weedone
245TCP	2,4,5-Trichlorophenol
245TP	2-(2,4,5-Trichlorophenoxy)propionicacid/Fenoprop
246TCP	2,4,6-Trichlorophenol
24D	2,4-D/2,4-Dichlorophenoxyaceticacid
24DB	2,4-DB/4-(2,4-Dichlorophenoxy)butyricacid
24DCLP	2,4-Dichlorophenol
24DMPN	2,4-Dimethylphenol
24DNP	2,4-Dinitrophenol
24DNT	2,4-Dinitrotoluene
25DMPA	2,5-Dimethylphenanthrene
26DNT	2,6-Dinitrotoluene
2BEETO	2-(2-N-Butoxyethoxy) ethanol
2CHE1L	2-Cyclohexen-1-ol
2CHE1O	2-Cyclohexen-1-one
2CLEVE	2-Chloroethylvinyl ether
2CLP	2-Chlorophenol
2CNAP	2-Chloronaphthalene
2MC7	2-Methylheptane
2MNAP	2-Methylnaphthalene

Table 4.83 (continued)

Test Name	Analyte
2MNAP	2-Methylnaphthalene
2MP	2-Methylphenol
2MPYR	2-Methylpyrene
2NANIL	2-Nitroaniline
2NP	2-Nitrophenol
2PNAP	2-Phenylnaphthalene
2TMPD	2,6,10,14-Tetramethylpentadecane
33DCBD	3,3'-Dichlorobenzidine
3MO	3-Methyloctane
3NANIL	3-Nitroaniline
3S5E3L	B-Sitosterol/(3B)-Stigmast-5-en-3-ol
3S5E3L	beta-Sitosterol
46DN2C	4,6-Dinitro-2-cresol
4BRPPE	4-Bromophenylphenyl ether
4CANIL	4-Chloroaniline
4CL3C	3-Methyl-4-chlorophenol
4CLPPE	4-Chlorophenylphenyl ether
4MP	4-Methylphenol
4MPANR	4-Methylphenanthrene
4NANIL	4-Nitroaniline
4NP	4-Nitrophenol
678HPD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin
678HPF	1,2,3,4,6,7,8-Heptachlorodibenzofuran
678HXD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
678HXF	1,2,3,6,7,8-Hexachlorodibenzofuran
789HPF	1,2,3,4,7,8,9-Heptachlorodibenzofuran
789HXD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
789HXF	1,2,3,7,8,9-Hexachlorodibenzofuran
78HXDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin
78HXDF	1,2,3,4,7,8-Hexachlorodibenzofuran
78PCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin
78PCDF	1,2,3,7,8-Pentachlorodibenzofuran
ABHC	alpha-Benzenehexachloride
ACET	Acetone
ACLDAN	alpha-Chlordane
AENSLF	alpha-Endosulfan/Endosulfan I
AG	Silver
AL	Aluminum
ALDRN	Aldrin
ALK	Alkalinity
ALPHPN	a-Pinene
ALPHPN	alpha-Pinene
ANAPNE	Acenaphthene
ANAPYL	Acenaphthylene
ANTRC	Anthracene
ANTRQU	Athraquinone/9,10-Anthracenedione
AS	Arsenic
B	Boron

Table 4.83 (continued)

Test Name	Analyte
B2CEXM	bis (2-Chloroethoxy) methane
B2CIPE	bis (2-Chloroisopropyl) ether
B2CLEE	bis (2-Chloroethyl) ether
B2EHP	Bis (2-Ethylhexyl) phthalate
BA	Barium
BAANTR	Benzo[a]anthracene
BAPYR	Benzo[a]pyrene
BBFANT	Benzo[b]fluoranthene
BBFLRE	Benzo[b]fluorene
BBHC	beta-Benzenehexachloride
BBZP	Butylbenzylphthalate
BE	Beryllium
BENSLF	beta-Endosulfan/Endosulfan II
BENZOA	Benzoic acid
BEPYR	Benzo[e]pyrene
BGHIPY	Benzo[g,h,i]perylene
BKFANT	Benzo[k]fluoranthene
BOD	Biological oxygen demand
BRDCLM	Bromodichloromethane
BZALC	Benzyl alcohol
C10	Decane
C11	Undecane
C11	Hendecane
C12	Dodecane
C13	Tridecane
C13DCP	cis-1,3-Dichloropropene
C14	Tetradecane
C14A	Myristic acid/Tetradecanoic acid
C15	Pentadecane
C16	Hexadecane
C16A	Palmitic acid/Hexadecanoic acid
C16AME	Hexadecanoic acid methyl ester
C17	Heptadecane
C18	Octadecane
C19	Nonadecane
C20	Eicosane
C21	Heneicosane
C22	Docosane
C23	Tricosane/n-Tricosane
C25	Pentacosane
C27	Heptacosane
C28	Octacosane
C29	Carbazole
CARBAZ	Nonacosane
C2AVE	Acetic acid, vinyl ester
C2H3CL	Vinyl chloride
C2H5CL	Chloroethane
C6H6	Benzene

Table 4.83 (continued)

Test Name	Analyte
C6HOH	Cyclohexanol
C7	Heptane
C8	Octane
C9	Nonane
CA	Calcium
CAMP	Camphor
CAPLCT	Caprolactam
CARBAZ	Carbazole
CCL3F	Trichlorofluoromethane
CCL4	Carbon tetrachloride
CD	Cadmium
CH2CL2	Methylene chloride
CH3BR	Bromomethane
CH3CL	Chloromethane
CHBR3	Bromoform
CHCL3	Chloroform
CHRY	Chrysene
CL	Chloride
CL6BZ	Hexachlorobenzene
CL6CP	Hexachlorocyclopentadiene
CL6ET	Hexachloroethane
CLC6H5	Chlorobenzene
CO	Cobalt
COD	Chemical oxygen demand
CR	Chromium
CS2	Carbon disulfide
CU	Copper
CYN	Cyanide
DALA	Dalapon
DBAHA	Dibenzo[a,h]anthracene
DBHC	delta-Benzenehexachloride
DBRCLM	Dibromochloromethane
DBZFUR	Dibenzofuran
DBZTHP	Dibenzothiophene
DCAMBA	Dicamba
DEGLYC	Diethylene glycol/2,2-Oxybis[ethanol]
DEMBZA	N,N-Diethl-3-methylbenzamide/N,N-Diethl-m-toluamide
DEP	Diethylphthalate
DHDMAC	9,10-Dihydro-9,9-dimethylacridine
DICP	2-(2,4-Dichlorophenoxy)propionic acid
DICP	Dichloroprop
DIESEL	Diesel fuel
DINO	Dinoseb
DLDRN	Dieldrin
DMOATE	Dimethoate
DMP	Dimethylphthalate
DNBP	Di-N-butyl phthalate
DNOP	Di-N-octyl phthalate

Table 4.83 (continued)

Test Name	Analyte
DOAD	Dioctyl adipate/Hexanedioic acid dioctyl ester
ENDRN	Endrin
ENDRNA	Endrin aldehyde
ENDRNK	Endrin ketone
ESFSO4	Endosulfan sulfate
ET3MBZ	1-Ethyl-3-methylbenzene
ET4MBZ	1-Ethyl-4-methylbenzene/4-Ethyltoluene
ETC6H5	Ethylbenzene
ETCYHX	Ethylcyclohexane
F	Fluoride
FANT	Fluoranthene
FE	Iron
FLRENE	Fluorene
GAS	Gasoline
GCLDAN	gamma-Chlordane
GSITOS	gamma-Sitosterol/r-sitosterol/(3B,24S)-stigmast-5-en-3-ol/clionaste
HCBD	Hexachlorobutadiene
HG	Mercury
HPCL	Heptachlor
HPCLE	Heptachlor epoxide
HXCOS	Hexacosane
ICDPYR	Indeno[1,2,3-c,d]pyrene
ISOPBZ	Cumene/Isopropylbenzene/(1-Methylethyl)benzene
ISOPHR	Isophorone
K	Potassium
LIN	Lindane
MCPA	MCPA/(4-Chloro-2-methylphenoxy)aceticacid/4-Chloro-o-tolyloxy)aceticacid
MCPP	MCPP/2-(4-Chloro-2-methylphenoxy)propanoicacid/Mecoprop
MEC6H5	Toluene
MEK	Methylethyl ketone/2-Butanone/Methyleneketone
MEXCLR	Methoxychlor
MG	Magnesium
MIBK	Methylisobutyl ketone
MN	Manganese
MNBK	Methyl-N-butyl ketone
NA	Sodium
NAP	Naphthalene
NB	Nitrobenzene
NH3	Ammonia
NI	Nickel
NIT	Nitrite, Nitrate - nonspecific
NNDNPA	N-Nitrosodi-N-propylamine
NNDPA	N-Nitrosodiphenylamine
OCDD	Octachlorodibenzodioxin - nonspecific
OCDF	Octachlorodibenzofuran - nonspecific
ODECA	Stearic acid/Octadecanoic acid/Promulsin/Provisco
PB	Lead
PCB016	PCB 1016/Aroclor 1016

Table 4.83 (continued)

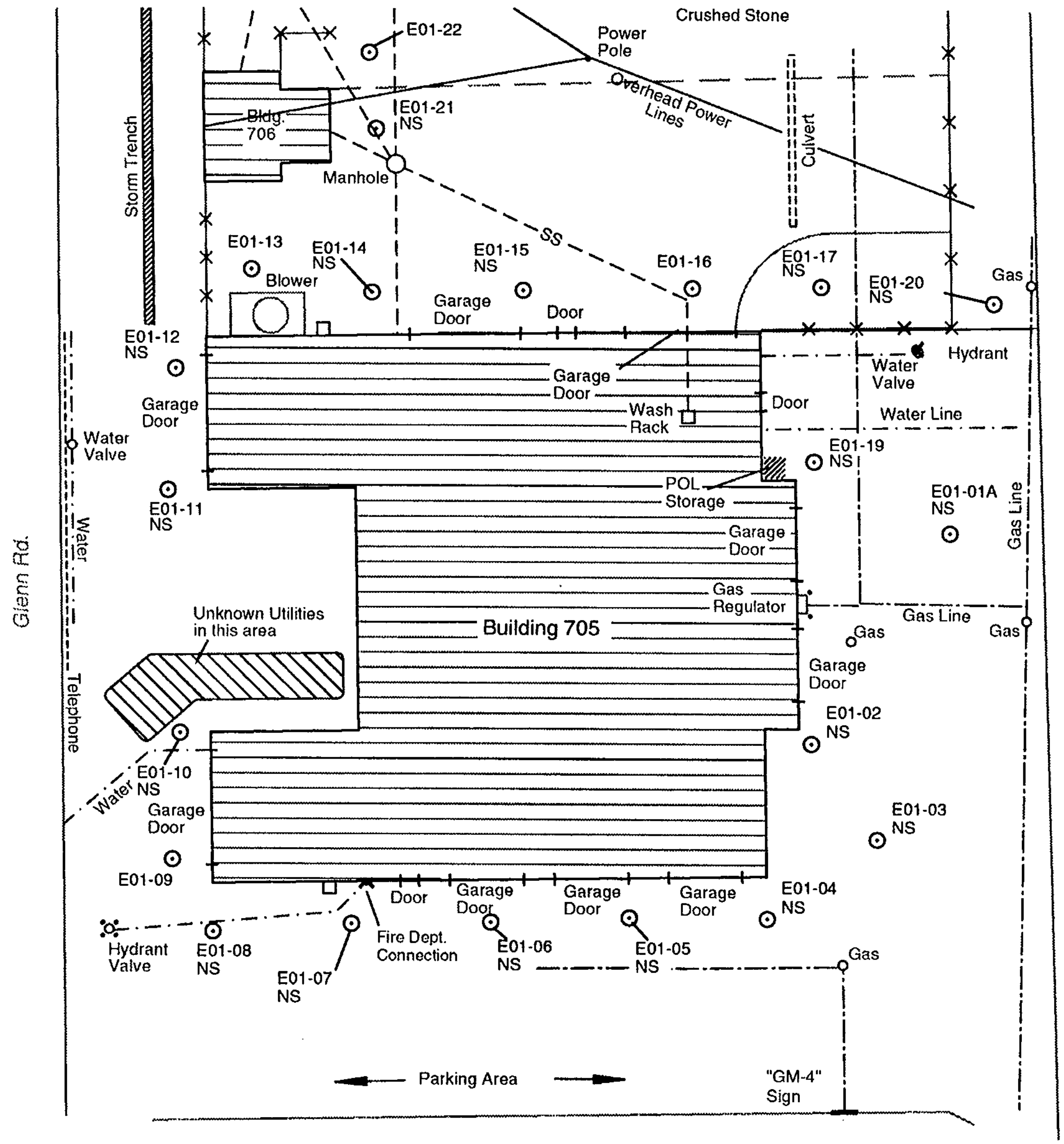
Test Name	Analyte
PCB221	PCB 1221/Aroclor 1221
PCB232	PCB 1232/Aroclor 1232
PCB242	PCB 1242/Aroclor 1242
PCB248	PCB 1248/Aroclor 1248
PCB254	PCB 1254/Aroclor 1254
PCB260	PCB 1260/Aroclor 1260
PCP	Pentachlorophenol
PCYMEN	p-Cymene/4-(1-Methylethl)toluene/Dolcymene/1-Methy
PH	pH
PHANTR	Phenanthrene
PHENOL	Phenol
PPDDD	2,2-bis (p-Chlorophenyl)-1,1-dichloroethane/4,4'-DDD
PPDDE	2,2-bis (p-Chlorophenyl)-1,1-dichloroethene/4,4'-DDE
PPDDT	2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane/4,4'-DDT
PRC6H5	N-Propylbenzene/Propylbenzene/1-Phenylpropane
PYR	Pyrene
SB	Antimony
SE	Selenium
SO4	Sulfate
STYR	Styrene
T13DCP	trans-1,3-Dichloropropene
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TCDF	2,3,7,8-Tetrachlorodibenzofuran
TCLEA	1,1,2,2-Tetrachloroethane
TCLEE	Tetrachloroethene
TCLTFE	1,1,2-Trichlor-1,2,2-trifluoroethane
TCOS	Tetracosane
TDS	Total dissolved solids
THCDD	Total hexachlorodibenzo-p-dioxins
THCDF	Total hexachlorodibenzofurans
THPCDD	Total heptachlorodibenzo-p-dioxins
THPCDF	Total heptachlorodibenzofurans
TL	Thallium
TOC	Total organic carbon
TPCDD	Total pentachlorodibenzo-p-dioxins
TPCDF	Total pentachlorodibenzofurans
TPHENC	Total recoverable phenolics
TRCLE	Trichloroethene
TTCDD	Total tetrachlorodibenzo-p-dioxins
TTCDF	Total tetrachlorodibenzofurans
TXPHEN	Toxaphene
TXYLEN	Xylenes, total combined
V	Vanadium
XYLEN	o,p-Xylene
ZN	Zinc

Table 4.83 (continued)

Explanation of Qualifiers

Qualifier	Explanation
/?	Control chart either not received or not yet approved by the Army; qualifier applied during Army data review
b	Value is undetected because of method blank contamination; flag applied during independent data validation
B	Analyte detected in the associated method blank or quality control blank as well as the sample; flag applied by laboratory
C	Analysis was confirmed
D	Duplicate analysis
F	Sample filtered prior to analysis
/I	The low-spike recovery is high; qualifier applied during Army data review
j	Value is estimated; flag applied during independent data validation
/J	The low-spike recovery is low; qualifier applied during Army data review
J	The value is estimated
/K	Reported results are affected by interferences or high background; qualifier applied during Army data review
K	Missed holding times for extraction and preparation; qualifier applied during Army data review
/L	Missed holding time for sample analysis; qualifier applied during Army data review
/M	The high-spike recovery is high; qualifier applied during Army data review
/N	The high-spike recovery is low: qualifier applied during Army data review
P	The value is less than the reporting limit, but greater than instrument detection limit
/R	Value is unacceptable; qualifier applied during Army data review
R	Nontarget compound analyzed for and detected (non-gas chromatography/mass spectrometry [GC/MS] method)
rr	Value was found unacceptable during independent data validation
S	Nontarget compound analyzed for and detected (gas chromatography/mass spectrometry methods)
x	Analyte recovery outside of certified range but within acceptable limits

FBH/FBH015B 9/11/95 LDZ



Explanation

—×—×—	Fence
POL	Petroleum, oils, and lubricants
- - -SS- - -	Sanitary sewer
⊙	Soil-gas sampling location
NS	No soil-gas sample could be collected

N

0 30

Scale in feet

Harding Lawson Associates
Engineering and
Environmental Services

HLA

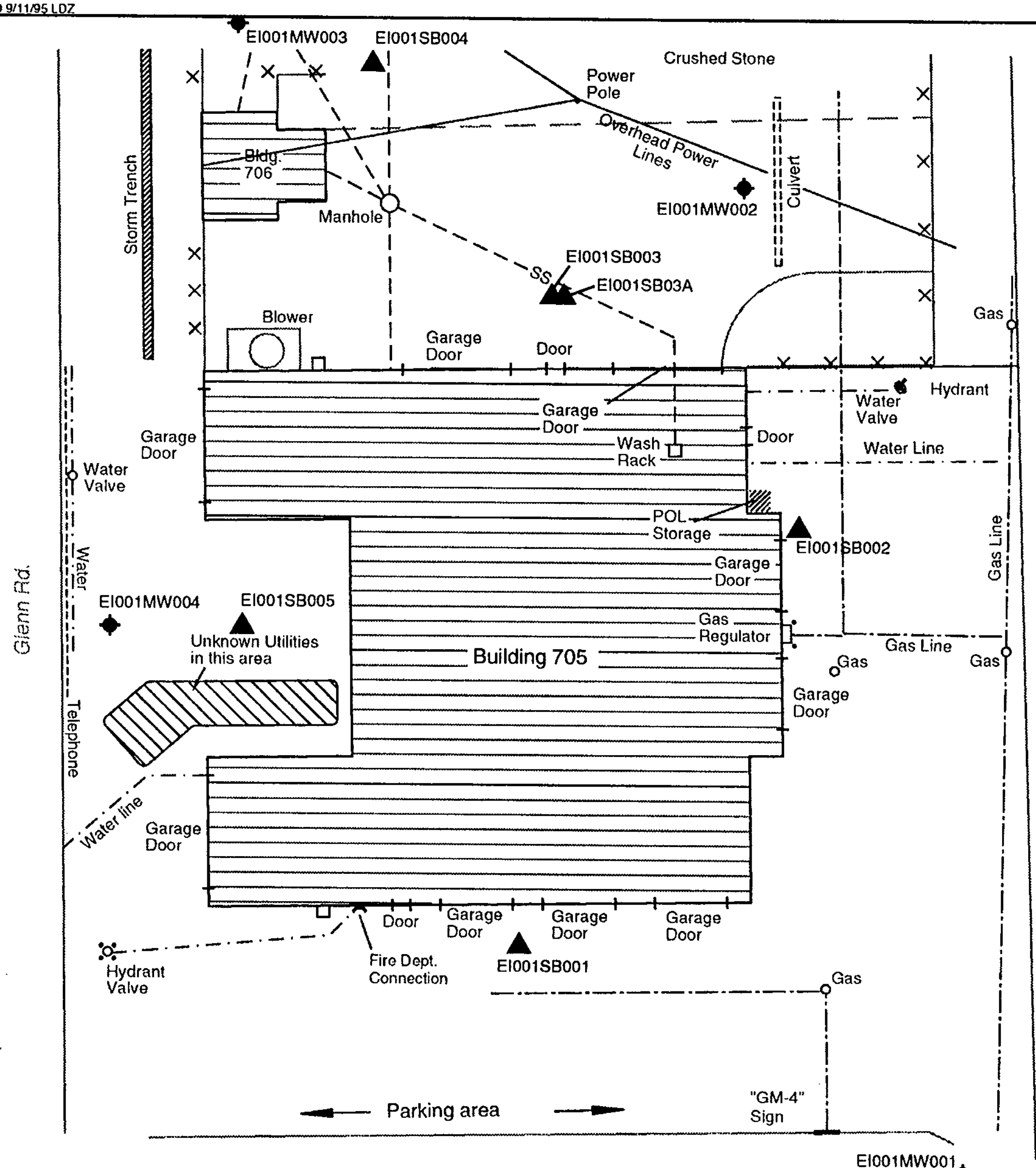
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Fort Benjamin Harrison
Marion County, Indiana

Figure 4.1

Soil-Gas Sampling Locations
at Auto Craft Shop, Building 705
(EI Site 1)

FBH/FBH015D 9/11/95 LDZ



Explanation

—x—x— Fence

POL Petroleum, oils, and lubricants

- - - SS - - Sanitary sewer

▲ Soil boring location

◆ Monitoring well location (HLA)

Note:

Boring EI001SB03A represents the resampling location of boring EI001SB003 because the original samples became warmer than 4°C at the laboratory due to a storage refrigerator malfunction.

N

0 30

Scale in feet

Harding Lawson Associates
Engineering and
Environmental Services

HLA

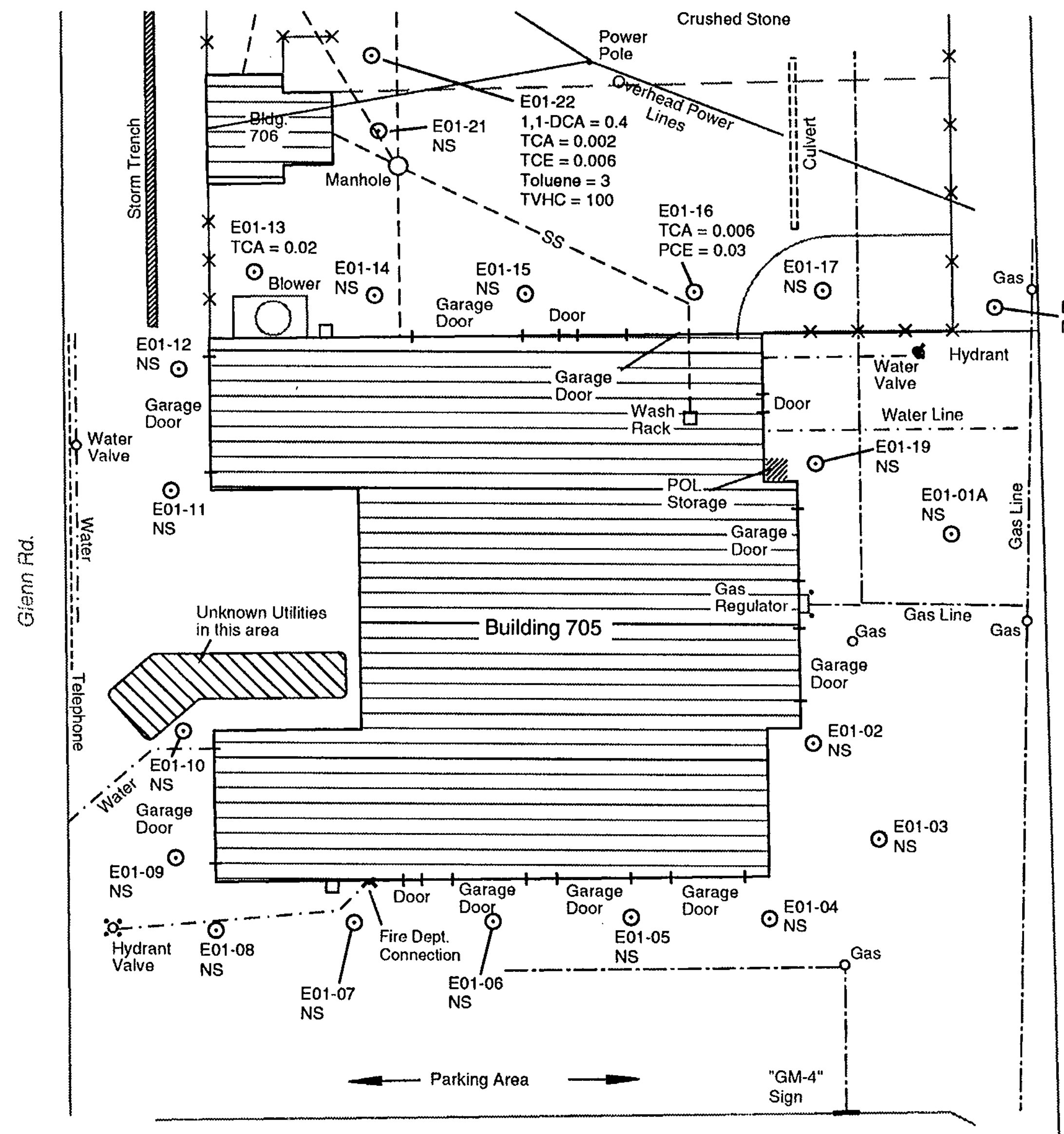
Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Fort Benjamin Harrison
Marion County, Indiana

Figure 4.2

Soil Boring and Monitoring Well Locations at Auto Craft Shop, Building 705 (EI Site 1)

FBH/FBH015C 9/12/95 LDZ



Explanation

—x—x—	Fence
POL	Petroleum, oils, and lubricants
– – –SS– – –	Sanitary sewer
⊙	Soil-gas sampling location
NS	No soil-gas sample could be collected
Note:	All values are shown in micrograms per liter (ug/l).

Soil-gas results taken from Vapor Trace Soil-Gas Investigation Report by Tracer Research Corporation.

1,1-DCA	1,1-Dichloroethane
PCE	Tetrachloroethene
TCA	Trichloroethane
TCE	Trichloroethene
TVHC	Total volatile hydrocarbons

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Environmental Services

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Aberdeen Proving Ground, Maryland

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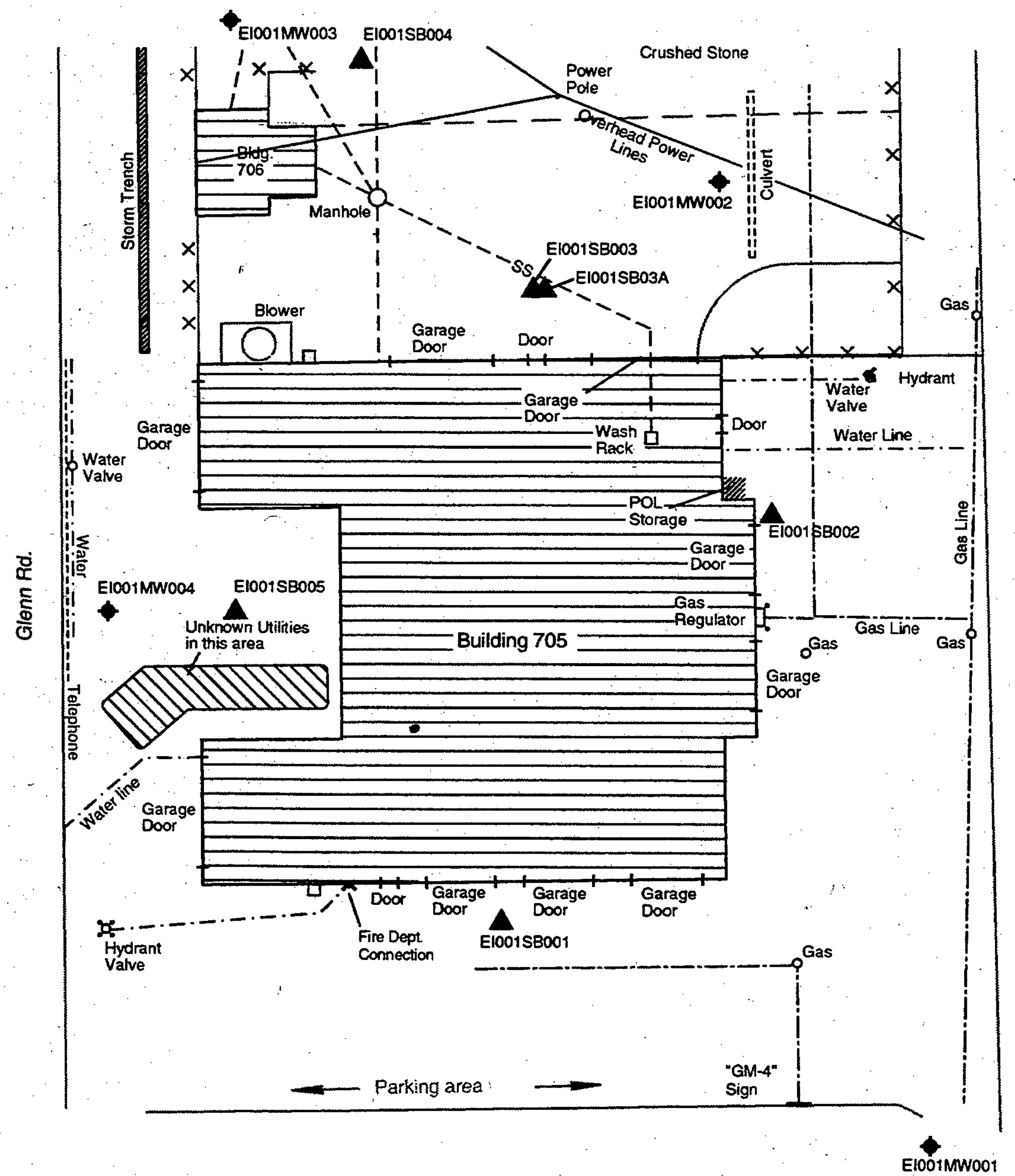
Marion County, Indiana

Figure 4.3

Soil-Gas Sampling Results at Auto Craft Shop, Building 705 (EI Site 1)



EI001SB0	
2 ft.	ACE
2 ft.	NA
2 ft.	TL
4 ft.	TCL
4 ft.	CO
4 ft.	TL
7.5 ft.	TCL
7.5 ft.	CO
7.5 ft.	CU
7.5 ft.	NI
7.5 ft.	TL
7.5 ft.	ZN

EI001SB0	
2.5 ft.	TCL
2.5 ft.	AS
2.5 ft.	NA
2.5 ft.	TL

EI001SB0	
3 ft.	ACE
3 ft.	TCL
3 ft.	AS
3 ft.	BA
3 ft.	CO
3 ft.	MN
3 ft.	TL
5 ft.	AS
5 ft.	TL
9 ft.	TCL
9 ft.	BA
9 ft.	CO
9 ft.	CU
9 ft.	FE
9 ft.	MN
9 ft.	NI
9 ft.	TL
9 ft.	V
9 ft.	ZN

EI001SB0	
2 ft.	BA
2 ft.	MN
2 ft.	PB
2 ft.	SE
2 ft.	TL
4 ft.	AS
4 ft.	BA
4 ft.	BE
4 ft.	CO
4 ft.	CR
4 ft.	FE
4 ft.	MN
4 ft.	NI
4 ft.	PB
4 ft.	TL
4 ft.	V
4 ft.	ZN
10 ft.	CR
10 ft.	CU
10 ft.	FE
10 ft.	NI
10 ft.	TL
10 ft.	V
10 ft.	ZN

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SB001		
ACET	.014	
NA	417	
TL	34.8	
TCLTFE	.0079	S
CO	7.13	
TL	29.4	
TCLTFE	.008	S
CO	5.59	
CU	12.6	
NI	16	
TL	30.8	
ZN	40	

SB001-DUP		
TCLTFE	.0068	DS
AS	16	D
NA	419	D
TL	34	D

SB002		
ACET	.019	
TCLTFE	.01	S
AS	11	
BA	93.8	
CO	6.86	
MN	389	
TL	36.6	
AS	8.5	
TL	31.7	
TCLTFE	.0068	S
BA	52.5	
CO	6.61	
CU	16	
FE	13700	
MN	353	
NI	18.2	
TL	37.6	
V	18.2	
ZN	43.3	

SB003	
BA	291
MN	692
PB	52.2
SE	.413
TL	25.5
AS	7.95
BA	231
BE	.949
CO	11.8
CR	28.2
FE	28200
MN	538
NI	32.1
PB	17.9
TL	41
V	51.3
ZN	76.9
CR	10.6
CU	13.5
FE	12400
NI	16.9
TL	36
V	15.8
ZN	40.5

EI001SB004		
2 ft.	ACET	.026
2 ft.	BA	122
2 ft.	NA	500
2 ft.	SE	.476
4 ft.	ACET	.037
4 ft.	AS	9.9
4 ft.	BA	105
4 ft.	BE	.962
4 ft.	DIESEL	14.4
6 ft.	ACET	.023
6 ft.	AS	9.3
6 ft.	BE	.733

EI001SB005		
2.5 ft.	BA	139
2.5 ft.	CO	11.6
2.5 ft.	CR	30.3
2.5 ft.	FE	30300
2.5 ft.	NA	530
2.5 ft.	SE	.619
2.5 ft.	TL	34.1
4 ft.	ACET	.027
4 ft.	AS	10
4 ft.	BA	216
4 ft.	BE	.889
4 ft.	CO	14
4 ft.	CR	28
4 ft.	FE	29200
4 ft.	MN	1070
4 ft.	NI	34.3
4 ft.	PB	16.5
4 ft.	TL	39.4
4 ft.	ZN	82.6
6 ft.	AS	6.8
6 ft.	MN	372
6 ft.	TL	29.3

EI001SB005-DUP			
3.5 ft.	ACET	.028	D
3.5 ft.	AS	13	D
3.5 ft.	BA	166	D
3.5 ft.	BE	.879	D
3.5 ft.	CO	9.81	D
3.5 ft.	CR	26.8	D
3.5 ft.	FE	31800	D
3.5 ft.	MN	548	D
3.5 ft.	NI	29.3	D
3.5 ft.	SE	.713	D
3.5 ft.	TL	36.9	D
3.5 ft.	V	45.9	D
3.5 ft.	ZN	80.3	D

EI001SB03A		
2 ft.	ACET	.031

EI001MW004	
CH3CL	2 JP

Explanation

—×——×—	Fence
POL	Petroleum, oils, and lubricants
– – – SS – –	Sanitary sewer
▲	Soil boring location
⯁	Monitoring well location (HLA)

Notes:

1. Boring EI001SB03A represents the resampling location of boring EI001SB003 because the original samples became warmer than 4°C at the laboratory due to a storage refrigerator malfunction.
2. All analyte concentrations for soil borings are in milligrams per kilogram (mg/kg).
3. See Table 4.83 for analyte and qualifier definitions.

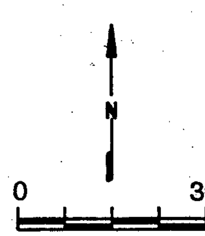

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Figure 4.4

Soil Boring and Monitoring Well Sampling Results at Auto Craft Shop, Building 705 (EI Site 1)

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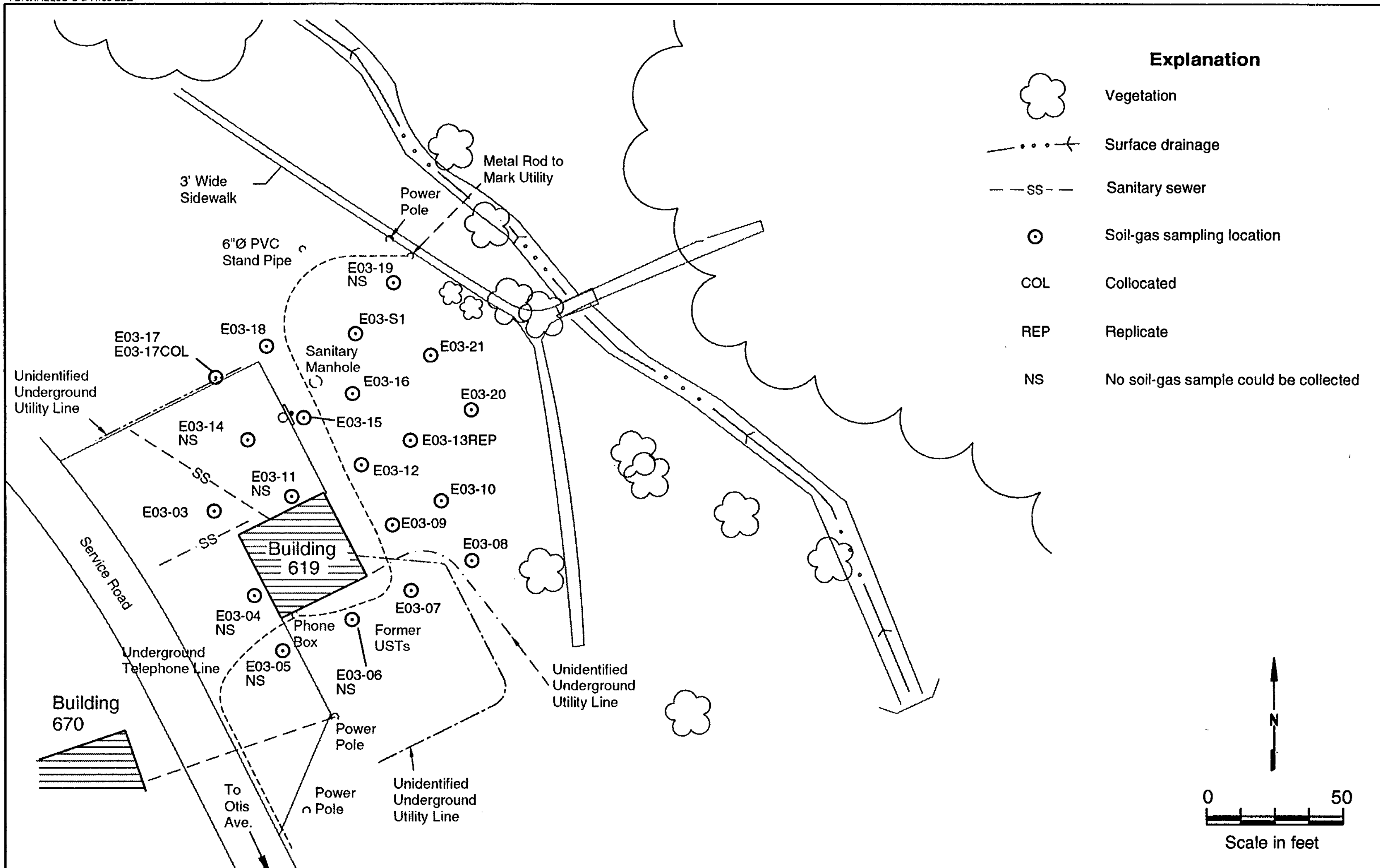

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Figure 4.5

Soil-Gas Sampling Locations at Former Post Exchange (PX) Gasoline Station, Building 619 (EI Site 3)

FBH/AREE8C-B 9/11/95 LDZ

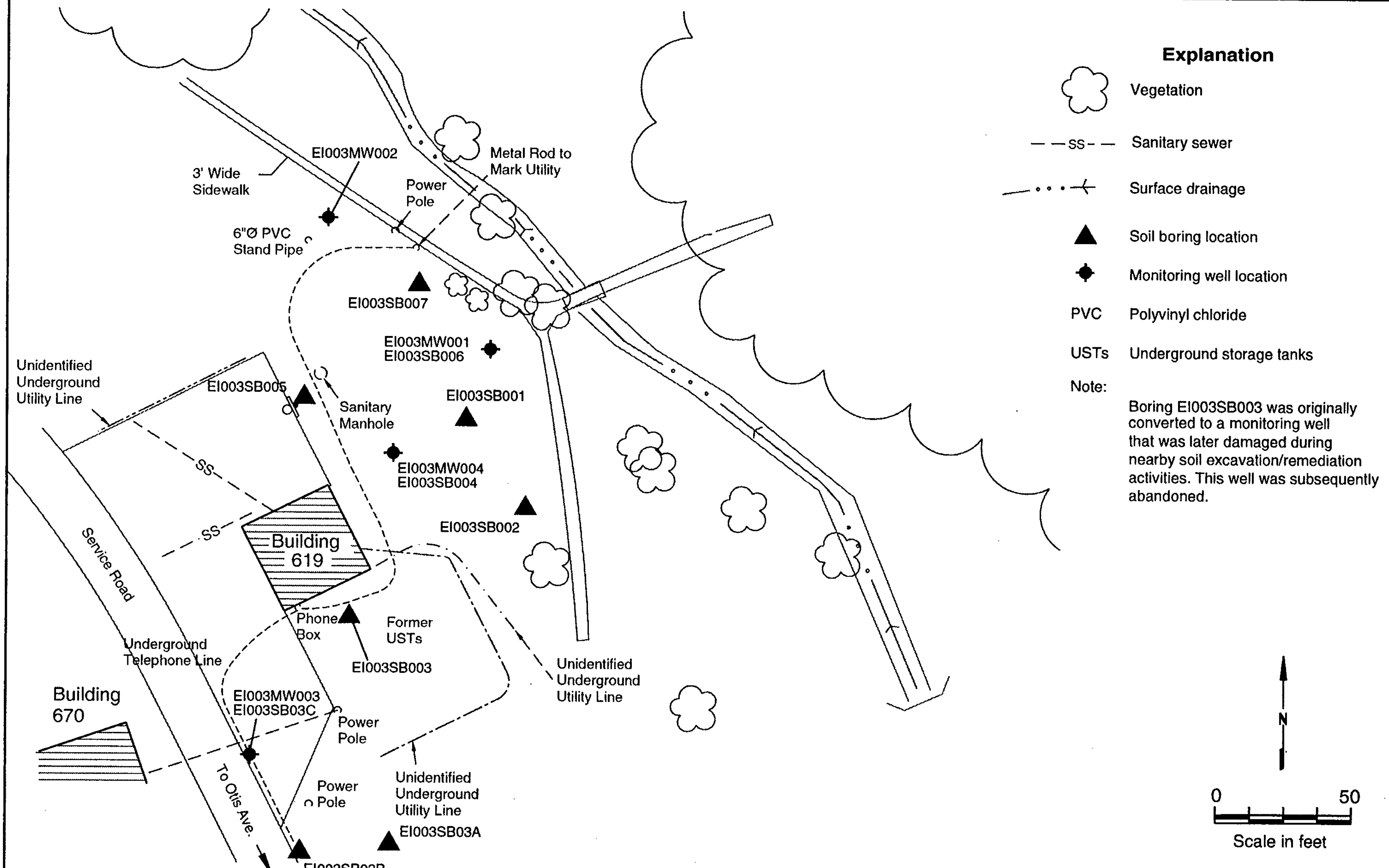

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Figure 4.6

Soil Boring and Monitoring Well Locations at Former Post Exchange (PX) Gasoline Station, Building 619 (EI Site 3)

FBH/AREE8C-D 9/12/95 LDZ

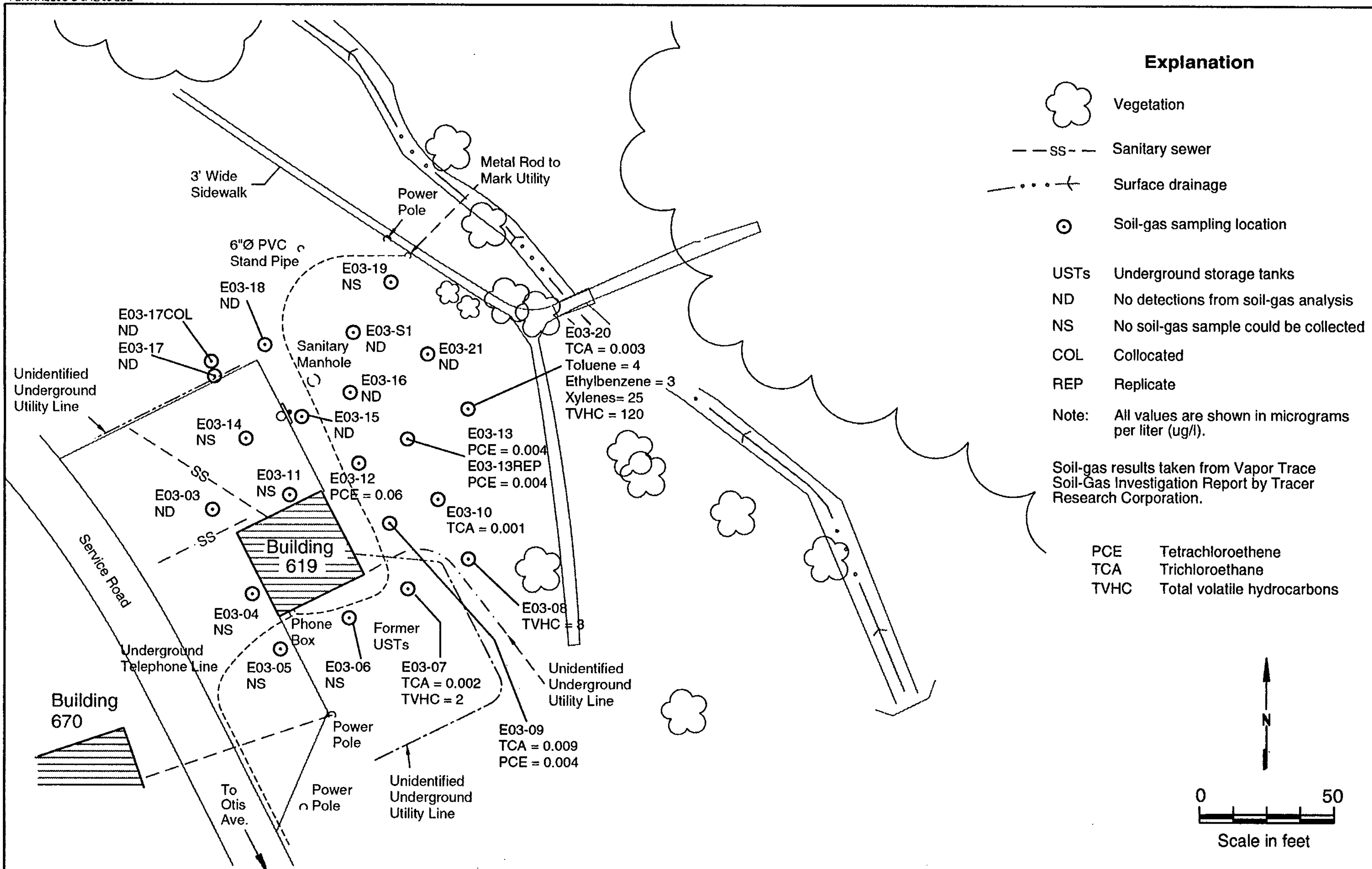

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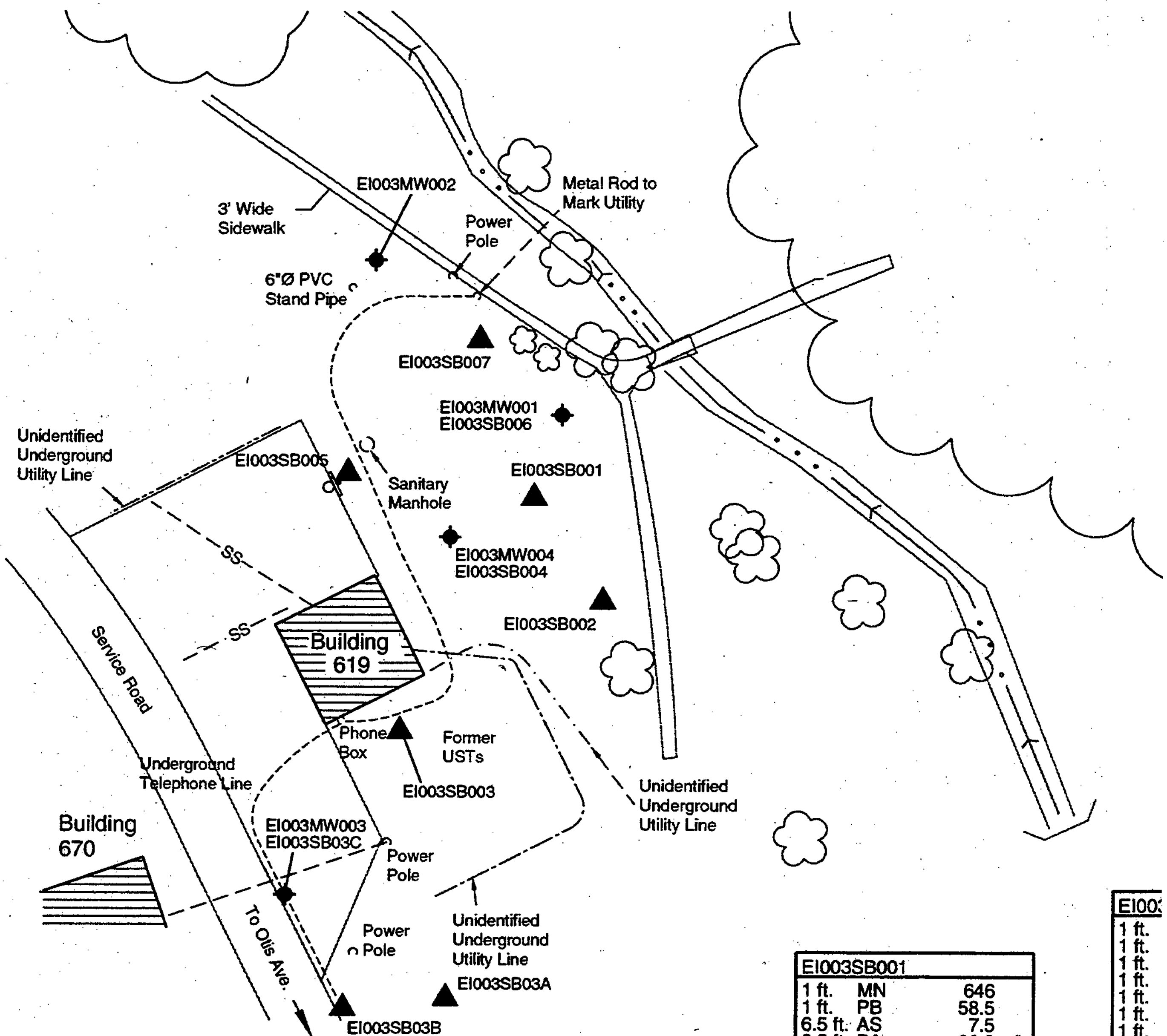
Figure 4.7

Soil-Gas Sampling Results at Former Post Exchange (PX) Gasoline Station, Building 619 (EI Site 3)

FBH/AREE8CSB 9/11/95 LDZ



EI003MW002	
CHCL3	4.3

EI003SB002			
1 ft.	PB	87.5	
4.5 ft.	AS	7.2	/I
4.5 ft.	MN	383	
4.5 ft.	PB	62.2	
8 ft.	AS	6.9	/I
8 ft.	BA	57.7	
8 ft.	CO	6.23	
8 ft.	CR	13.8	/J
8 ft.	CU	17.3	/IR
8 ft.	FE	16100	
8 ft.	NI	17.3	
8 ft.	PB	34.6	
8 ft.	V	21.9	/JR
8 ft.	ZN	63.4	

EI003SB001			
1 ft.	MN	646	
1 ft.	PB	58.5	
6.5 ft.	AS	7.5	
6.5 ft.	BA	86.8	/L
6.5 ft.	CO	8.43	/L
6.5 ft.	MN	491	/L
6.5 ft.	PB	88.1	/L
6.5 ft.	SE	.579	
12.5 ft.	CO	4.07	
12.5 ft.	CR	7.07	
12.5 ft.	CU	11.8	
12.5 ft.	FE	9220	
12.5 ft.	MN	354	
12.5 ft.	NI	10.7	
12.5 ft.	PB	6	
12.5 ft.	SE	.5	
12.5 ft.	TL	26.8	
12.5 ft.	V	8.68	
12.5 ft.	ZN	34.3	

EI003SB001-DUP			
5.5 ft.	BA	105	D
5.5 ft.	BE	.722	D
5.5 ft.	CO	8.47	D
5.5 ft.	PB	54.8	D
5.5 ft.	SE	.448	D
5.5 ft.	DIESEL	121	D
5.5 ft.	GAS	33.6	D

EI00
1 ft.
1 ft.
1 ft.
1 ft.
1 ft.
1 ft.
1 ft.
1 ft.
5 ft.
5 ft.
5 ft.
5 ft.
9 ft.
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9 ft.

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EI003SB003			
1 ft.	BA	320	
1 ft.	CD	.864	
1 ft.	CO	33.1	
1 ft.	FE	29600	
1 ft.	MN	4380	
1 ft.	NA	663	
1 ft.	PB	48.5	
1 ft.	ZN	93.5	
5 ft.	BA	87.8	
5 ft.	CO	7.34	
5 ft.	MN	481	
5 ft.	PB	40.9	
9 ft.	124MCH	1	S
9 ft.	1E2MB	1	S
9 ft.	2MC7	.6	S
9 ft.	3MO	1	S
9 ft.	BRDCLM	.1	
9 ft.	C6H6	.06	JP
9 ft.	C7	.6	S
9 ft.	C8	2	S
9 ft.	ETCYHX	1	S
9 ft.	MEC6H5	.2	
9 ft.	TXYLEN	1	
9 ft.	CO	5.76	
9 ft.	CR	11.2	/J
9 ft.	CU	15.8	/IR
9 ft.	FE	13600	
9 ft.	NI	18.1	
9 ft.	PB	6.55	
9 ft.	V	16.9	/JR
9 ft.	ZN	46.3	
9 ft.	DIESEL	21	/L
9 ft.	GAS	34.1	/L

EI003SB004			
1 ft.	PB	37.8	
5 ft.	PB	22.5	
11 ft.	CO	5.37	
11 ft.	CR	11.4	/J
11 ft.	CU	14.8	/IR
11 ft.	FE	13700	
11 ft.	MN	320	
11 ft.	NI	19.4	
11 ft.	PB	7.08	
11 ft.	TL	14.8	
11 ft.	V	14.8	/JR
11 ft.	ZN	44.5	

EI003SB005		
1.5 ft.	AS	22
1.5 ft.	SE	.5
1.5 ft.	TL	23.9
5 ft.	ACET	.014
5 ft.	AS	7
5 ft.	PB	35.9
5 ft.	SE	.301
5 ft.	TL	27.8
5 ft.	DIESEL	79.6
9.5 ft.	BA	57.4
9.5 ft.	CO	5.85
9.5 ft.	CR	10.8
9.5 ft.	CU	14.6
9.5 ft.	FE	12400
9.5 ft.	NI	16.9
9.5 ft.	PB	6.3
9.5 ft.	TL	28.1
9.5 ft.	V	18
9.5 ft.	ZN	43.9

Explanation

- Vegetation
- SS — Sanitary sewer
- Surface drainage
- Soil boring location
- Monitoring well location
- PVC — Polyvinyl chloride
- USTs — Underground storage tanks

Notes:

1. Boring EI003SB003 was originally converted to a monitoring well that was later damaged during nearby soil excavation/remediation activities. This well was subsequently abandoned.
2. All analyte concentrations for soil borings are in milligrams per kilogram (mg/kg). Analyte concentrations for monitoring wells (groundwater) are in micrograms per liter (ug/l).
3. See Table 4.83 for analyte and qualifier definitions.

N

0 50

Scale in feet

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Figure 4.8

Soil Boring and Monitoring Well Sampling Results at Former Post Exchange (PX) Gasoline Station, Building 619 (EI Site 3)

FBH/AREE12A6 9/11/95 LDZ

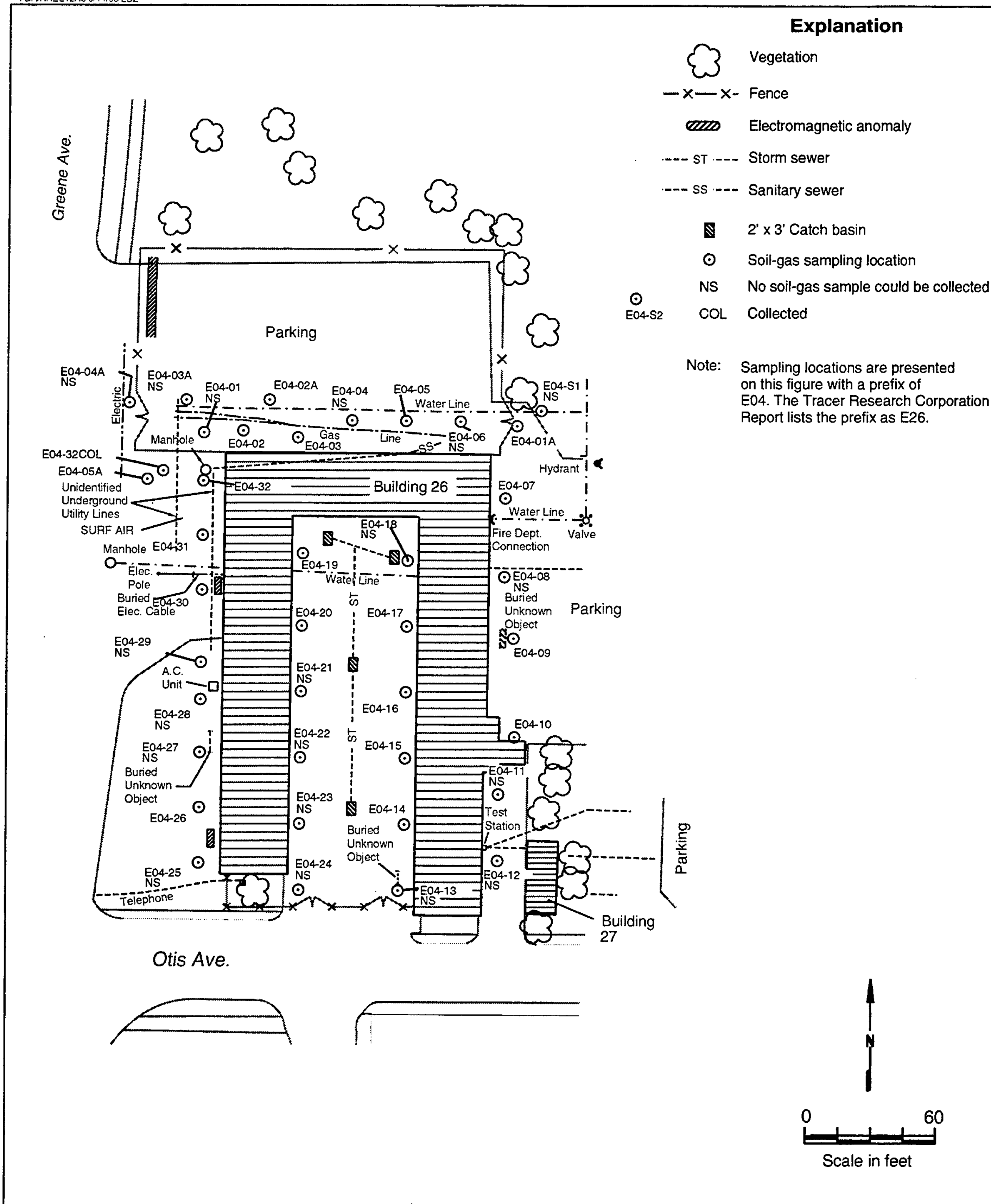

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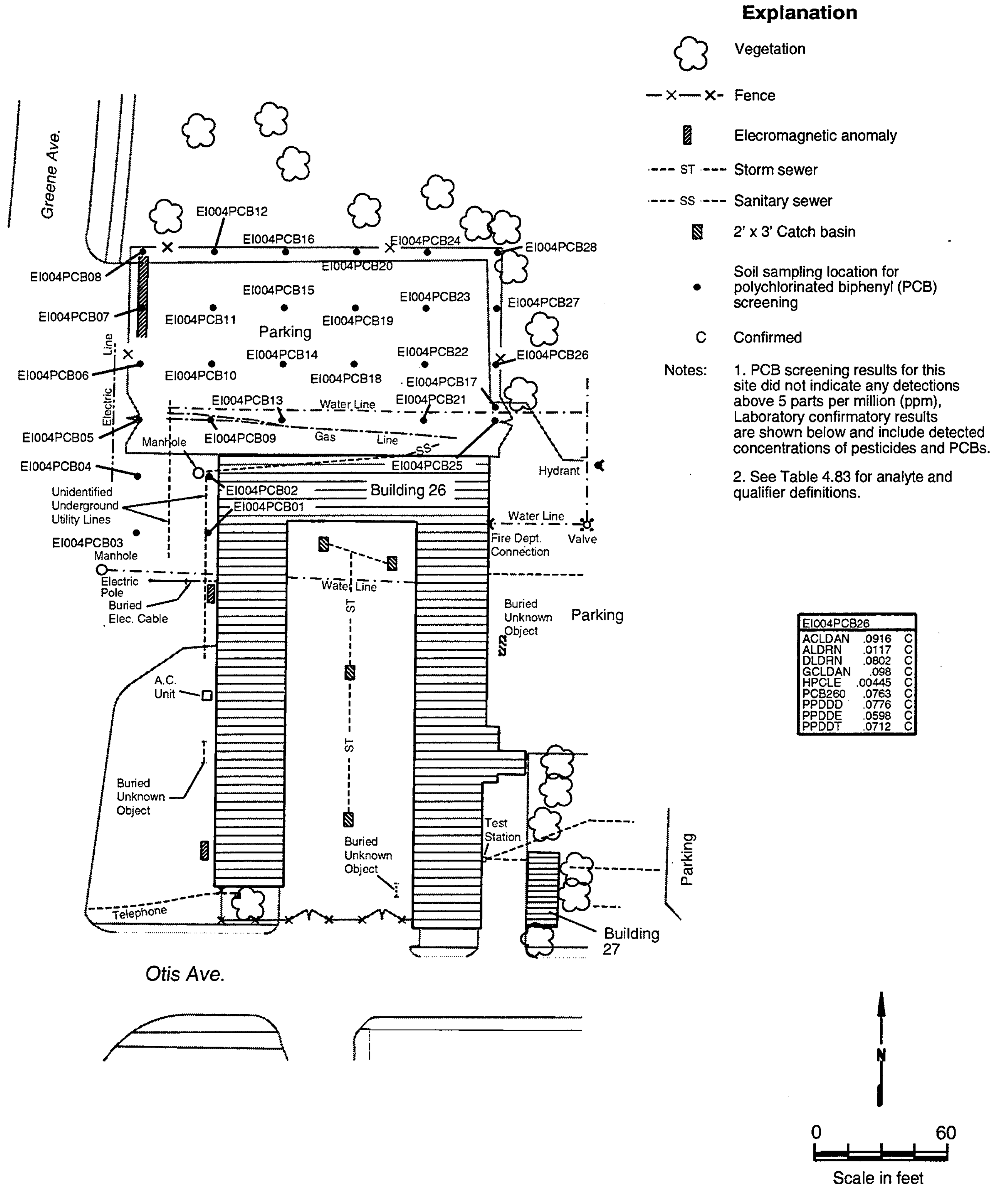
Figure 4.9

Soil-Gas Sampling Locations at Directorate of Installation Support (DIS), Engineering/ Maintenance, Building 26 (EI Site 4)

FBH/AREE12A4 9/11/95 LDZ



EI004PCB26		
ACLDAN	.0916	C
ALDRN	.0117	C
DLDRN	.0802	C
GCLDAN	.098	C
HPCLE	.00445	C
PCB260	.0763	C
PPDDD	.0776	C
PPDDE	.0598	C
PPDDT	.0712	C

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Figure 4.10

PCB Screening/Sampling Locations and Results at Directorate of Installation Support (DIS), Engineering/ Maintenance, Building 26 (EI Site 4)

FBH/AREE12A5 9/11/95 LDZ

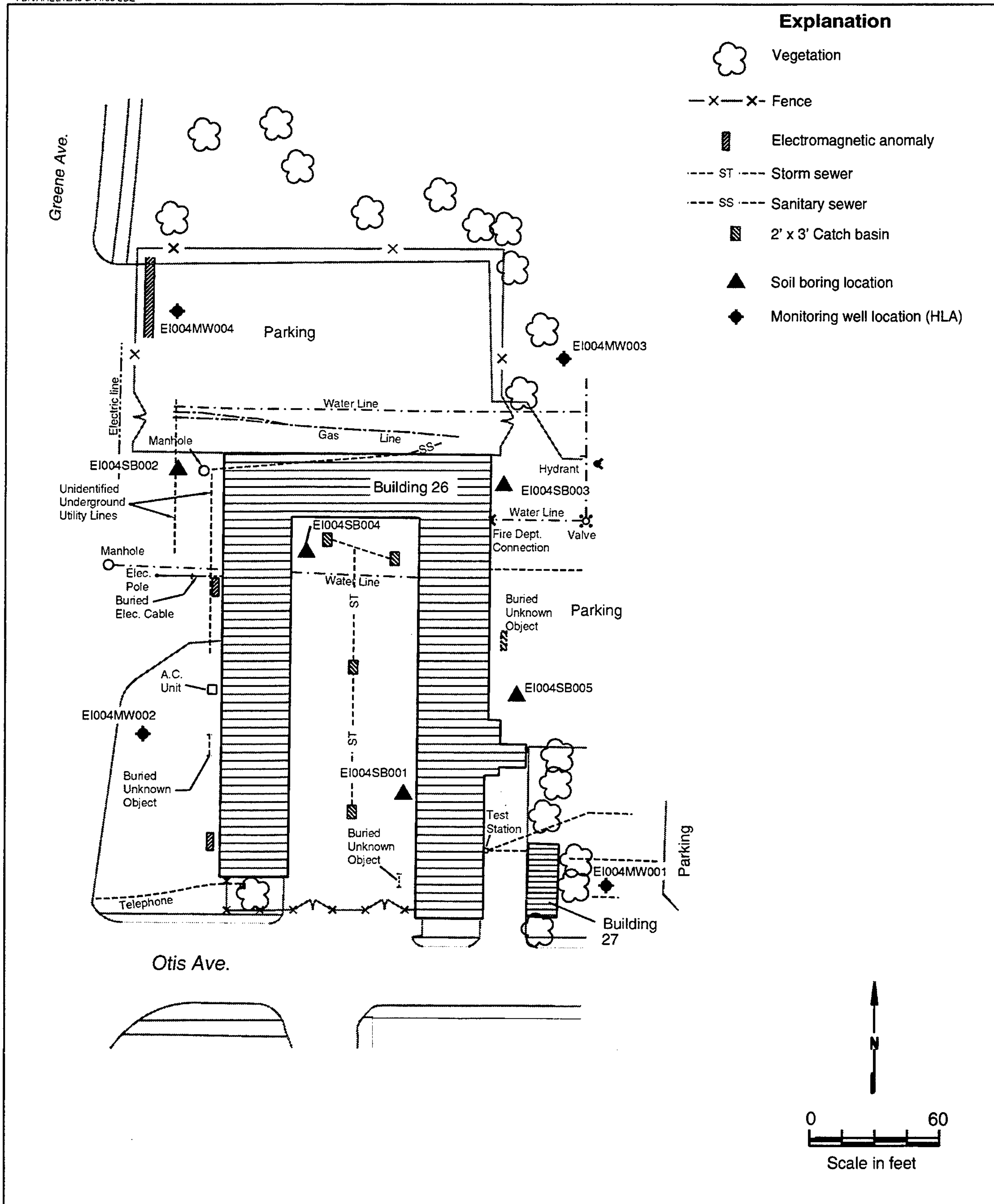

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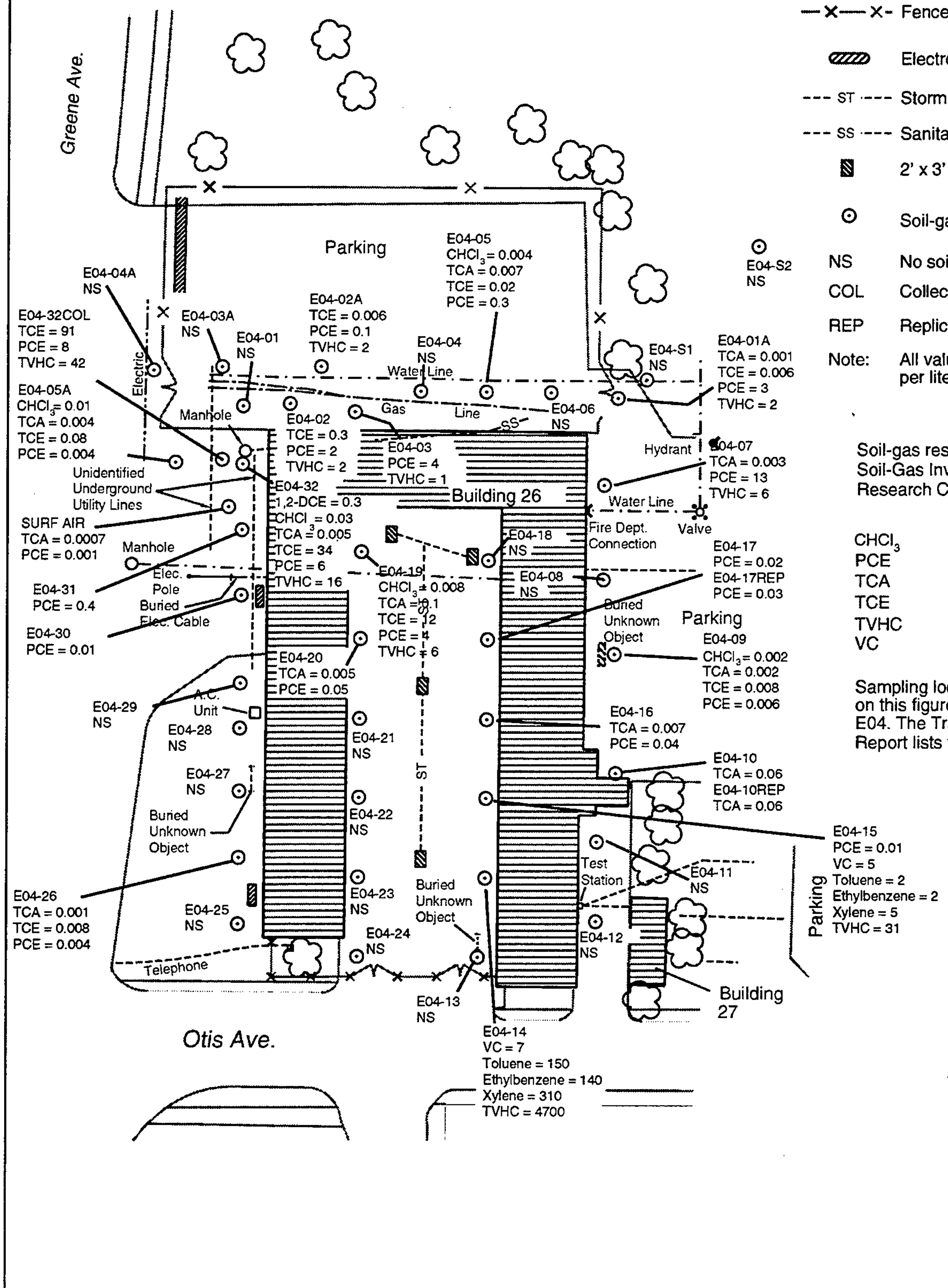
Figure 4.11
Soil Boring and Monitoring Well Locations at Directorate of Installation Support (DIS), Engineering/ Maintenance, Building 26 (EI Site 4)



Explanation

(symbol)	Vegetation
—X—X-	Fence
(symbol)	Electromagnetic anomaly
--- ST ---	Storm sewer
--- SS ---	Sanitary sewer
(symbol)	2' x 3' Catch basin
(symbol)	Soil-gas sampling location
NS	No soil-gas sample could be collected
COL	Collected
REP	Replicate
Note:	All values are shown in micrograms per liter (ug/l).

Soil-gas results taken from Vapor Trace Soil-Gas Investigation Report by Tracer Research Corporation.

$CHCl_3$	Chloroform
PCE	Tetrachloroethene
TCA	Trichloroethane
TCE	Trichloroethene
TVHC	Total volatile hydrocarbons
VC	Vinyl chloride

Sampling locations are presented on this figure with a prefix of E04. The Tracer Research Corporation Report lists the prefix as E26.

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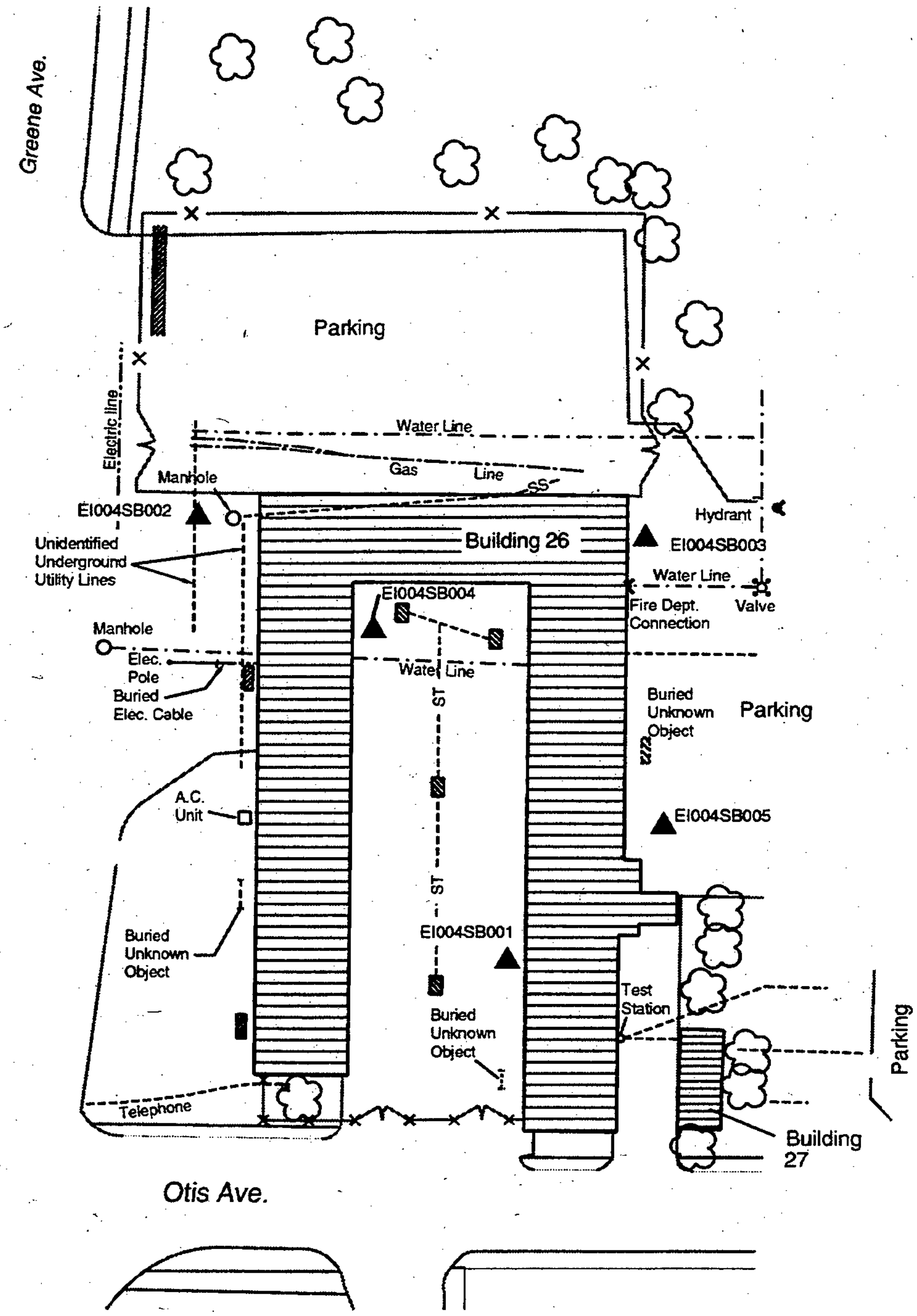
Figure 4.12
Soil-Gas Sampling Results at Directorate of Installation Support (DIS), Engineering/ Maintenance, Building 26 (EI Site 4)



EI004SB001	
3 ft.	ACET
3 ft.	DNBP
3 ft.	CO
3 ft.	TL
5 ft.	ACET
5 ft.	DNBP
5 ft.	CO
5 ft.	MN
5 ft.	TL
7 ft.	CU
7 ft.	FE
7 ft.	NI
7 ft.	TL
7 ft.	V

EI004SB002	
1 ft.	TRCLI
1 ft.	CYN
1 ft.	HG
1 ft.	NA
1 ft.	PB
1 ft.	SE
1 ft.	TL
1 ft.	ZN
1 ft.	DIESE
1 ft.	GAS
5 ft.	DNBP
5 ft.	AS
5 ft.	BA
5 ft.	CO
5 ft.	MN
5 ft.	NI
5 ft.	TL
17.5 ft.	TRCLI
17.5 ft.	C14
17.5 ft.	DNBP
17.5 ft.	AS
17.5 ft.	CO
17.5 ft.	CR
17.5 ft.	CU
17.5 ft.	FE
17.5 ft.	MN
17.5 ft.	NA
17.5 ft.	NI
17.5 ft.	TL
17.5 ft.	ZN

EI004SB002-	
5.5 ft.	ACET
5.5 ft.	TCLTF
5.5 ft.	TRCLI
5.5 ft.	DNBP
5.5 ft.	BE

B001	
ACET	.016
DNBP	.23
CO	6.87
TL	38.9
ACET	.014
DNBP	.86
CO	6.86
MN	377
TL	37.7
CU	14.7
FE	13600
NI	17
TL	33.9
V	13.6

B002		
TRCLE	.083	
CYN	.355	
HG	.233	
NA	559	
PB	88.5	
BE	.477	
TL	34.9	
ZN	93.1	
DIESEL	82.5	
GAS	63.1	
DNBP	.53	
AS	11.2	
BA	80.2	
CO	8.78	
MN	649	
NI	31.8	
TL	45.8	
TRCLE	1	
C14	.34	S
DNBP	.61	
AS	11	
CO	6.69	
CR	6.92	
CU	14.7	
FE	13600	
MN	272	
NA	454	
NI	17	
TL	23.8	
ZN	51	

B002-DUP		
ACET	.037	D
TCLTFE	.0067	DS
TRCLE	.023	D
DNBP	.27	D
BE	.714	D

EI004SB003		
3 ft.	DNBP	.26
3 ft.	BA	166
3 ft.	BE	1.03
3 ft.	CD	.913
3 ft.	CO	10.3
3 ft.	CU	28.5
3 ft.	FE	24900
3 ft.	MN	866
3 ft.	NI	72.4
3 ft.	TL	29.7
3 ft.	ZN	107
5.5 ft.	MN	468
5.5 ft.	TL	43.3
6 ft.	TCLEE	.017
6 ft.	DNBP	.2
6 ft.	CO	9.06
6 ft.	TL	38.3

EI004SB004			
3.3 ft.	TCLTFE	.0077	S
3.3 ft.	AS	10	
3.3 ft.	BA	114	
3.3 ft.	BE	.664	
3.3 ft.	CO	17.9	
3.3 ft.	CU	28.1	
3.3 ft.	FE	28100	
3.3 ft.	MN	460	
3.3 ft.	NI	26.8	
3.3 ft.	PB	15.3	
3.3 ft.	TL	35.8	
3.3 ft.	ZN	80.5	
5.5 ft.	AS	7.44	
5.5 ft.	MN	552	
5.5 ft.	TL	34.8	
20 ft.	B2EHP	.79	
20 ft.	AS	4.62	
20 ft.	MN	730	
20 ft.	TL	29	

EI004SB005		
1.5 ft.	DNBP	.26
1.5 ft.	NA	435
5.3 ft.	BA	108
5.3 ft.	BE	1.18
5.3 ft.	CO	8.53
5.3 ft.	FE	23800
5.3 ft.	MN	389
5.3 ft.	NI	26.3
5.3 ft.	PB	16.3
5.3 ft.	V	46.4
5.3 ft.	ZN	85.3
12 ft.	DNBP	.26
12 ft.	BA	45.8
12 ft.	CO	5.84
12 ft.	CR	11.4
12 ft.	CU	11.4
12 ft.	FE	11200
12 ft.	MN	297
12 ft.	NI	14.9
12 ft.	PB	5.84
12 ft.	V	17.2
12 ft.	ZN	34.3

EI004SB005-DUP			
5.8 ft.	DNBP	.2	D
5.8 ft.	BA	91.6	D
5.8 ft.	BE	.862	D

Explanation

Vegetation

—x—x- Fence

Electromagnetic anomaly

--- ST --- Storm sewer

--- SS --- Sanitary sewer

2' x 3' Catch basin

Soil boring location

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

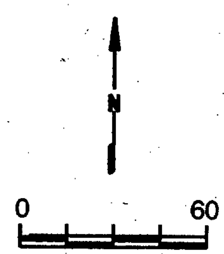


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Figure 4.13
Soil Boring Sampling Results at Directorate of Installation Support (DIS), Engineering/ Maintenance, Building 26 (EI Site 4)

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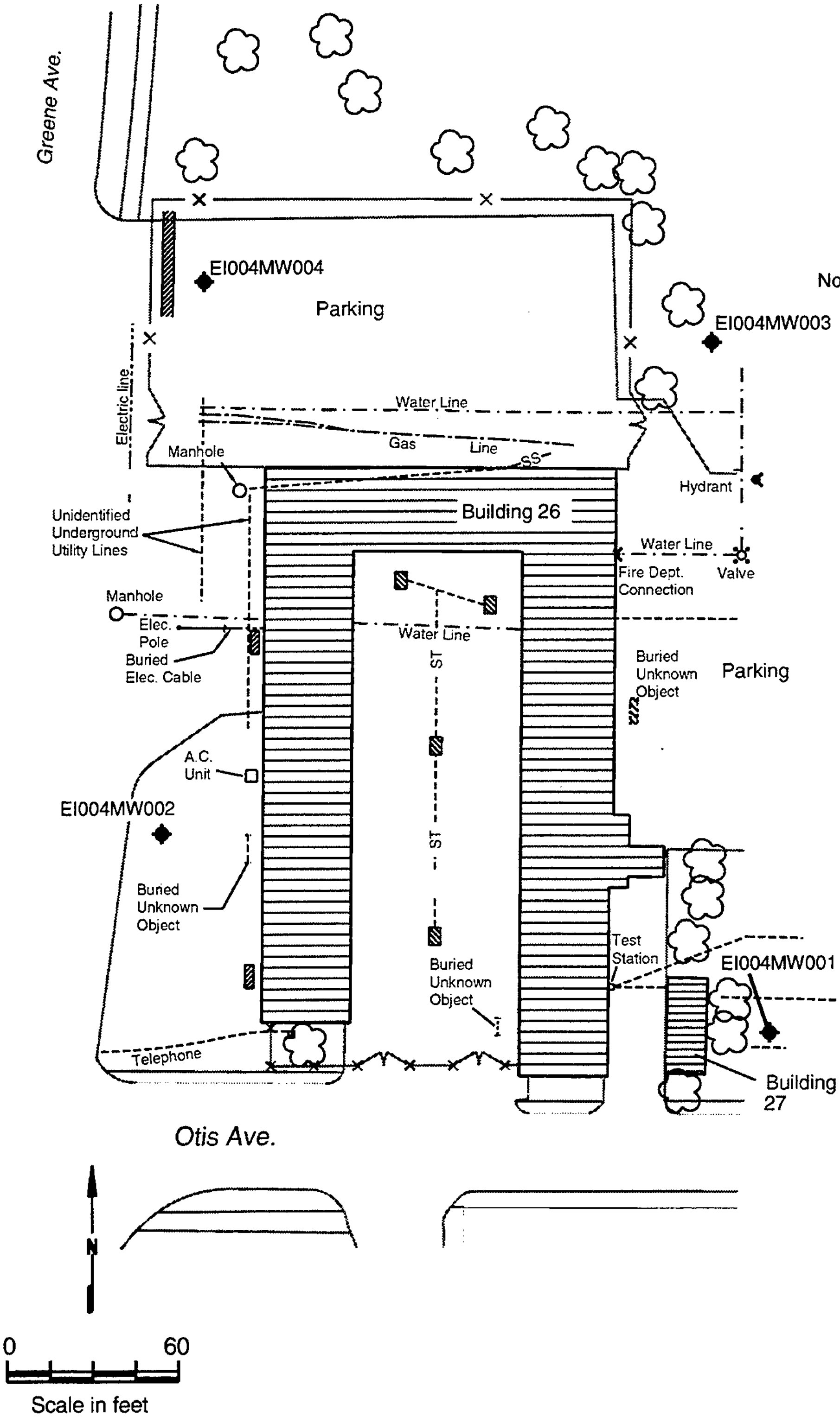

Explanation

- Vegetation
- Fence
- Electromagnetic anomaly
- ST Storm sewer
- SS Sanitary sewer
- 2' x 3' Catch basin
- Monitoring well location (HLA)

Notes:
1. All analyte concentrations are in micrograms per liter (ug/l).
2. See Table 4.83 for analyte and qualifier definitions.

EI004MW001		
AS	23.3	
AS	15.5	F
BA	130	F
BA	211	
CR	31.2	
CU	16.8	
FE	370	F
FE	14700	
MN	383	B
NA	26100	F
NA	26600	
NI	21.1	
PB	6.1	
V	26.7	
ZN	44.2	

EI004MW001-DUP		
CH3CL	3.1	D
AS	23	D
BA	122	DF
BA	166	D
CR	24.2	D
CU	16.5	D
FE	411	DF
FE	12500	D
MN	371	DB
NA	24400	DF
NA	25000	D
NI	22.9	D
PB	7.3	D
V	10.5	D
ZN	42.3	D

EI004MW002		
B2EHP	2.4	B
AS	8.4	
AS	5	F
CR	12.3	
CU	7.85	
FE	1130	F
FE	8120	
MN	373	
MN	237	F
NA	39600	/I
NA	38400	F/I
PB	2.6	

EI004MW003		
B2EHP	2.9	B
AS	32.7	
BA	184	
CR	44	
CU	45.2	
FE	38600	
MN	795	B
NA	62600	
NA	61100	F
NI	43.2	
PB	20.4	
SB	3.9	F
V	41.4	
ZN	145	

EI004MW004		
B2EHP	2.8	B
C6HOH	20	S
AS	18.5	
AS	16	F
FE	341	F
MN	195	FB
NA	70200	
NA	66400	F
SB	3.3	F

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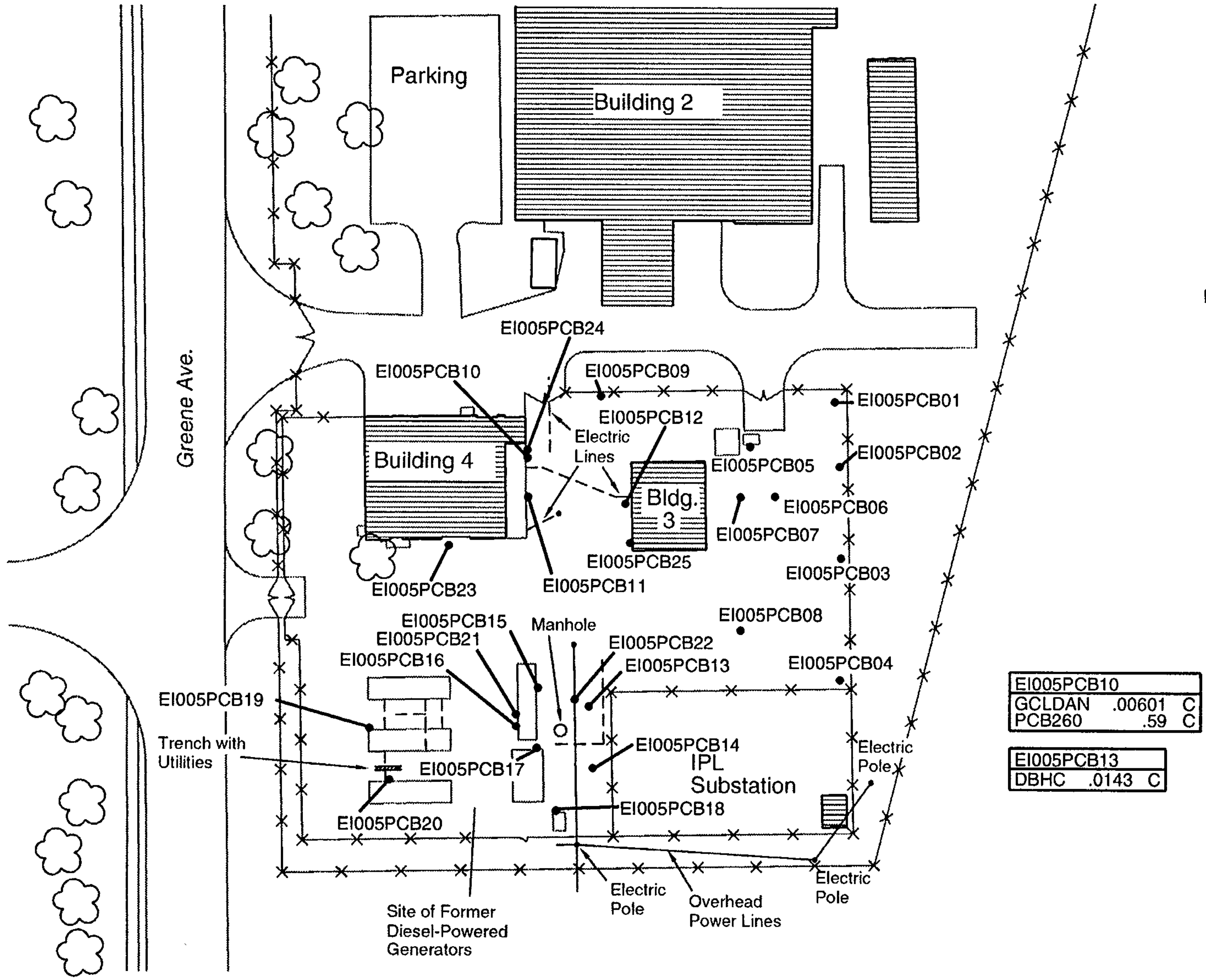
Figure 4.14

Monitoring Well Sampling Results at Directorate of Installation Support (DIS), Engineering/ Maintenance, Building 26 (EI Site 4)



Explanation

- Vegetation
- Fence
- Soil sampling location for polychlorinated biphenyl (PCB) screening
- IPL — Indiana Power and Light

Notes:

1. PCB screening results indicated greater than 5 parts per million (ppm) and less than 50 ppm for three samples (EI005PCB10, EI005PCB12, and EI005PCB13).
2. Laboratory analysis confirmed the detection for EI005PCB10 (0.590 ppm PCB 1260), but did not confirm the detection for EI005PCB13. HLA did not perform a confirmatory analysis on EI005PCB12.
3. All analyte concentrations are in milligrams per kilogram (mg/kg).
4. See Table 4.83 for analyte and qualifier definitions.

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Figure 4.15

PCB Screening Sample Locations and Results at Electrical Shop, Building 4 (EI Site 5)

FBH/FBH009D 9/11/95 LDZ

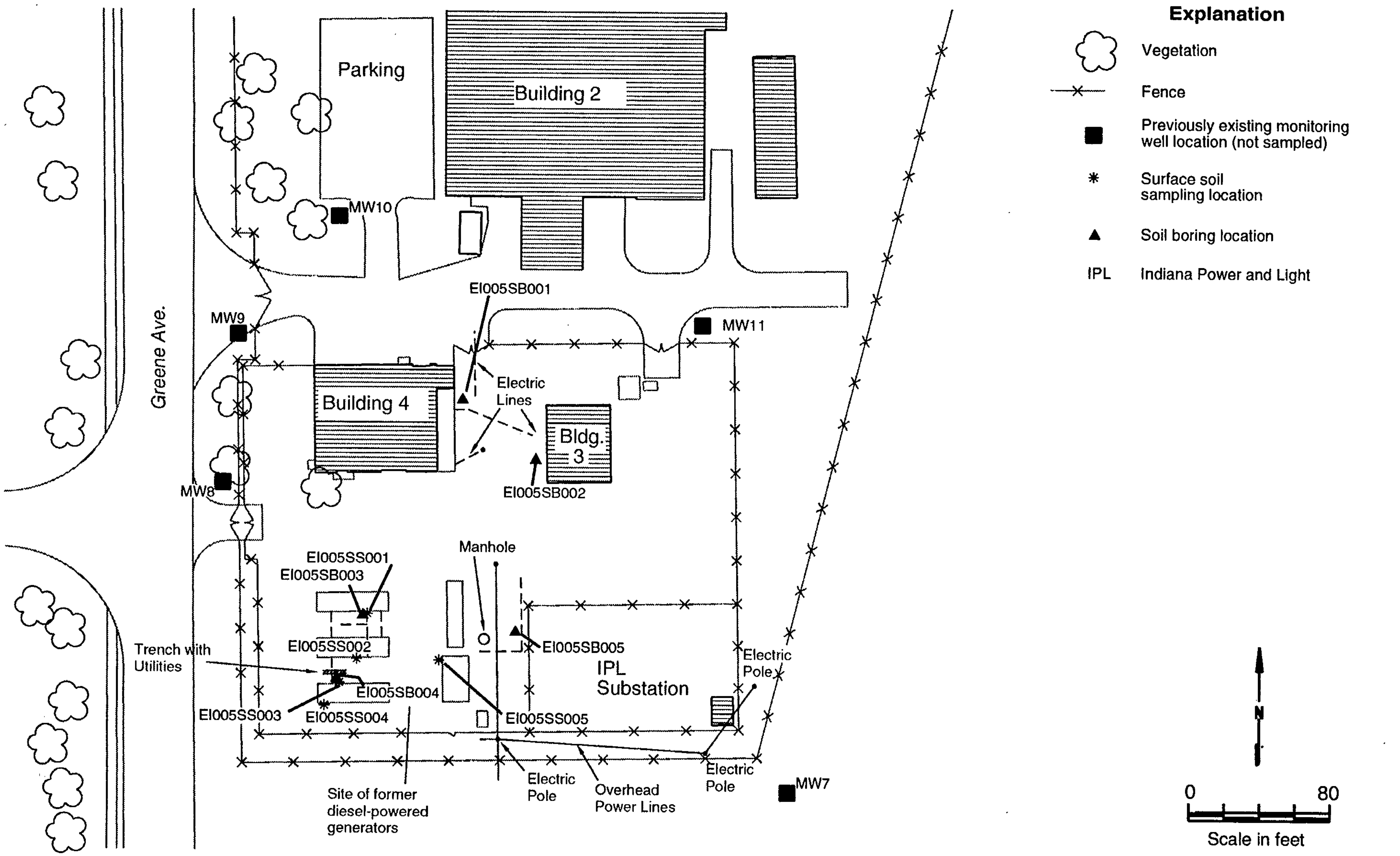

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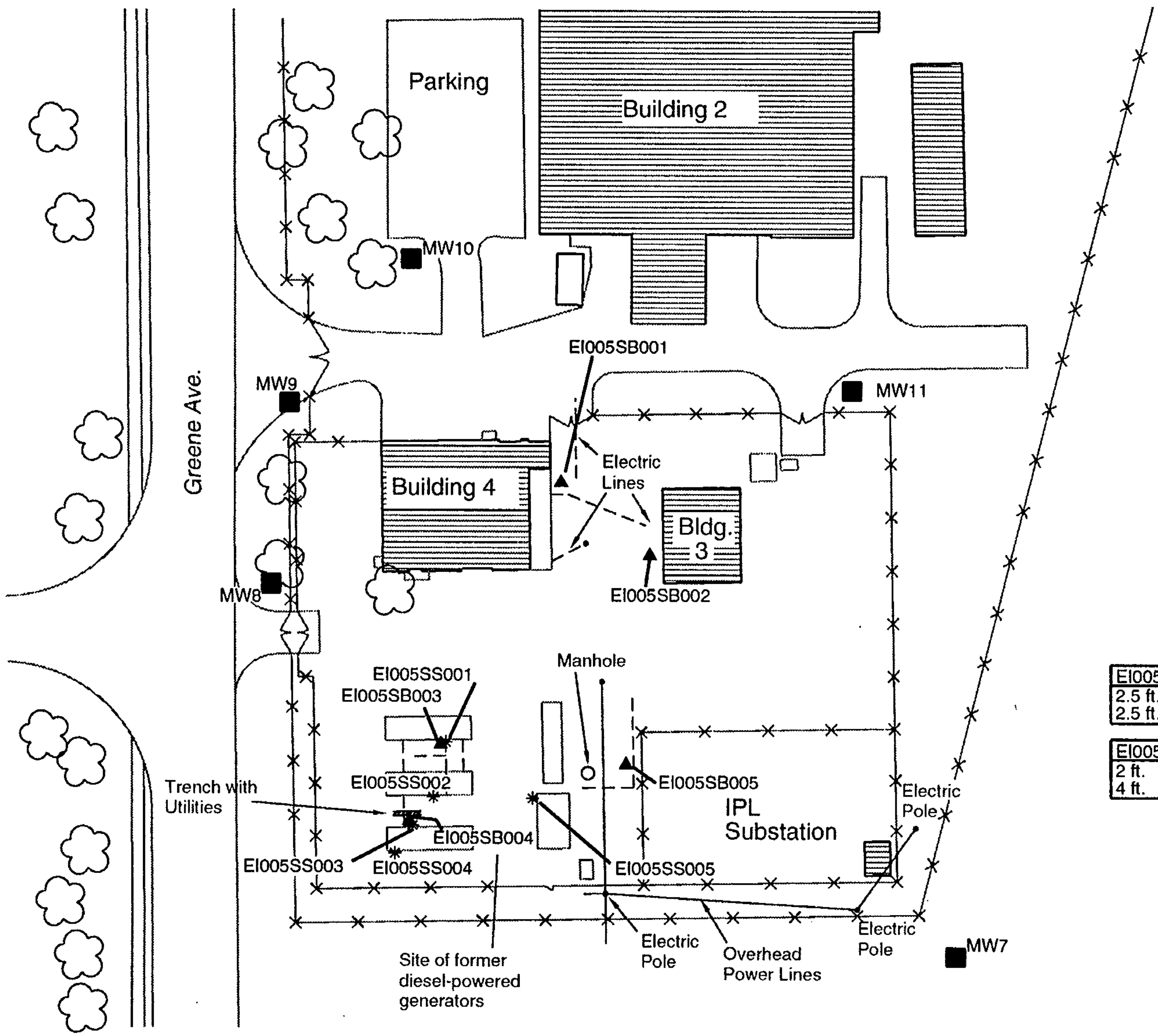
Figure 4.16

Surface Soil and Soil Boring Sampling Locations at Electrical Shop, Building 4 (EI Site 5)

FBH/FBH09DSS 9/11/95 LDZ



EI005SB002			
2.5 ft.	PPDDE	.01	C
2.5 ft.	PPDDT	.0185	C

EI005SB003		
2 ft.	DIESEL	20
4 ft.	DIESEL	520

Explanation

- Vegetation
- Fence
- Previously existing monitoring well location (not sampled)
- Surface soil sampling location
- Soil boring location
- IPL — Indiana Power and Light

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

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Figure 4.17

Surface Soil and Soil Boring Sampling Results at Electrical Shop, Building 4 (EI Site 5)

FBH/FBH014 9/11/95 LDZ

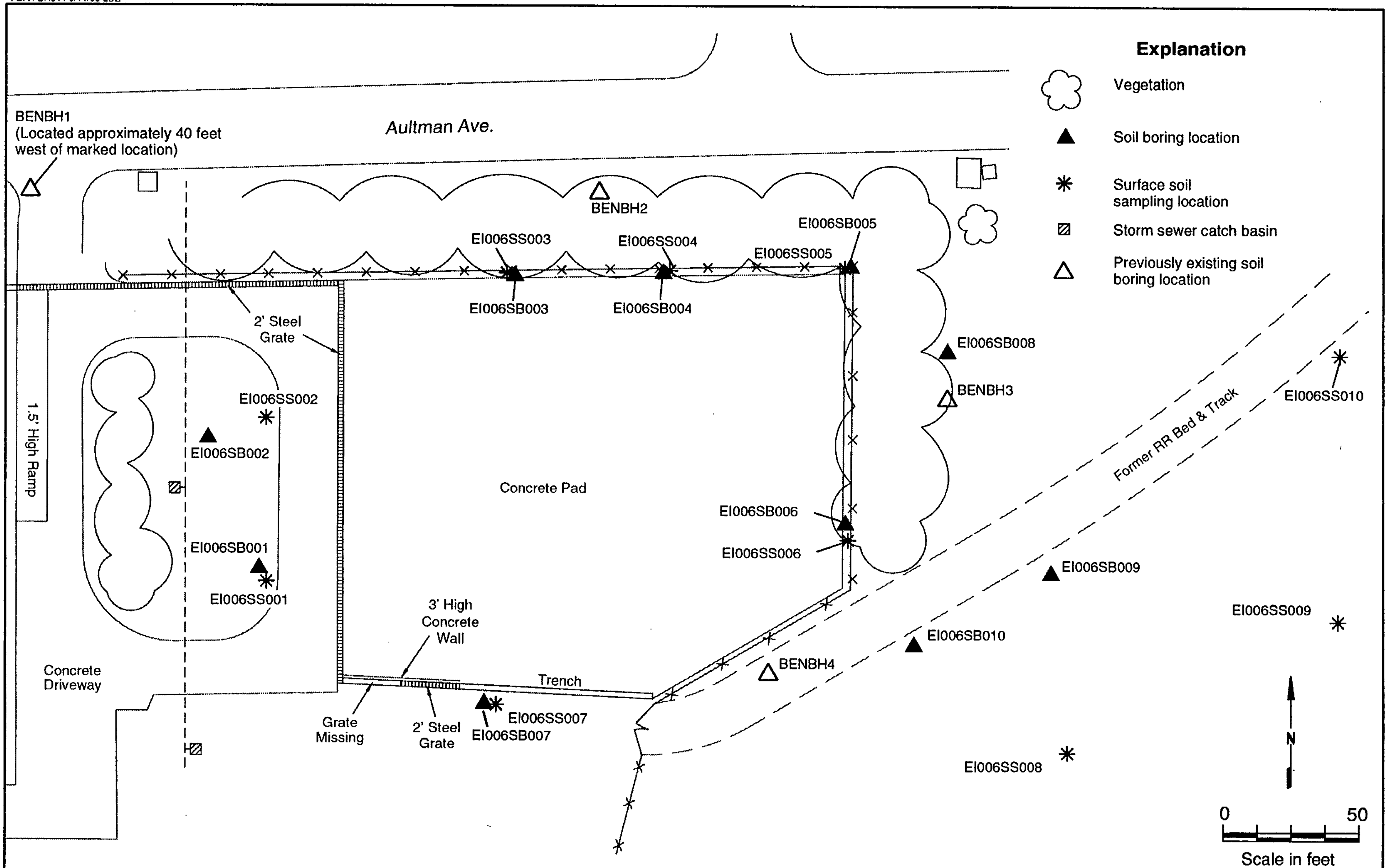

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Figure 4.18

Sampling Locations at Former Coal Storage Yard, Building 2
(EI Site 6)

FBH/FBH014SS 9/11/95 LDZ

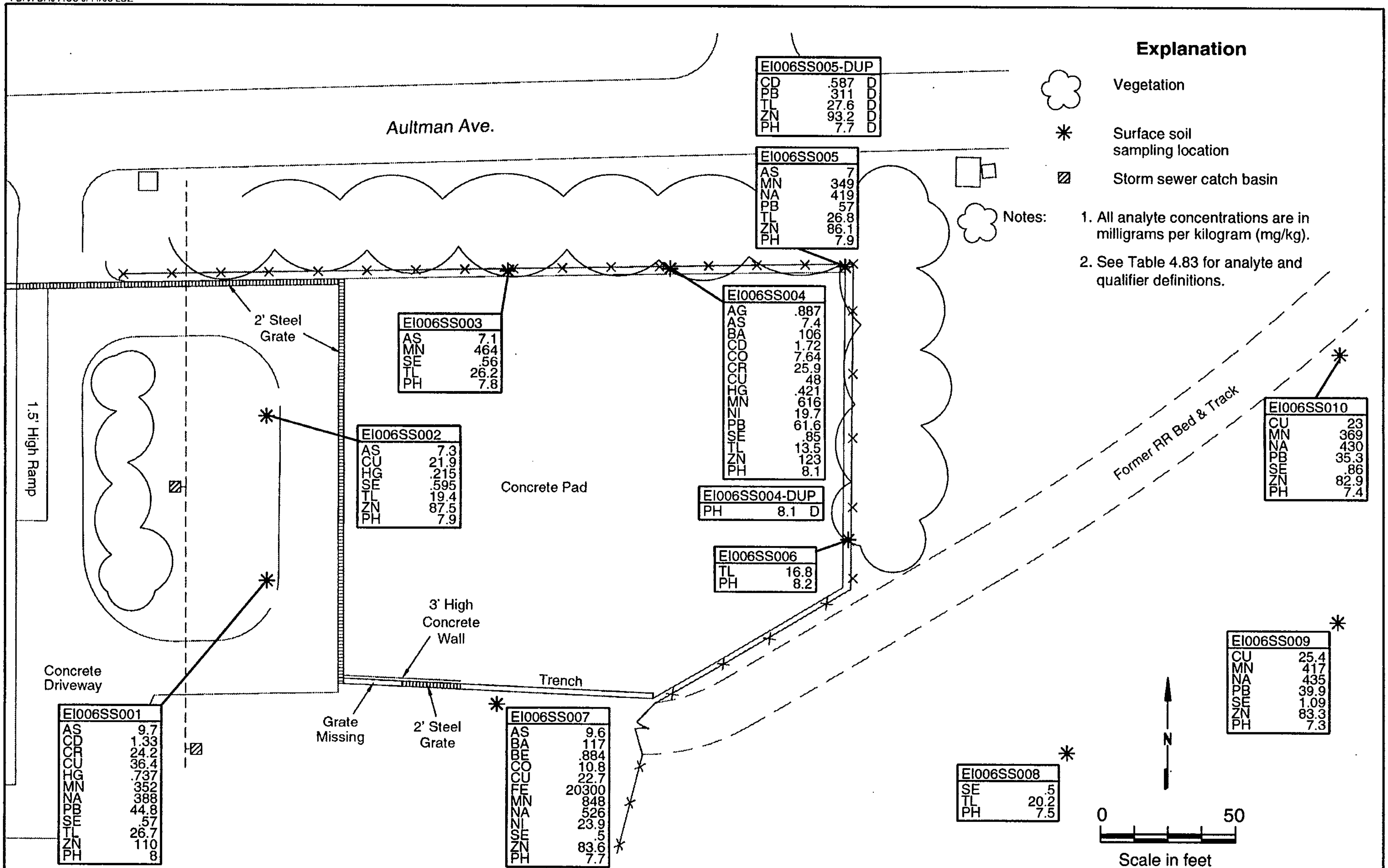

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Figure 4.19

Surface Soil Sampling Results at Former Coal Storage Yard, Building 2 (EI Site 6)

FBH/FBH014SB 9/11/95 LDZ

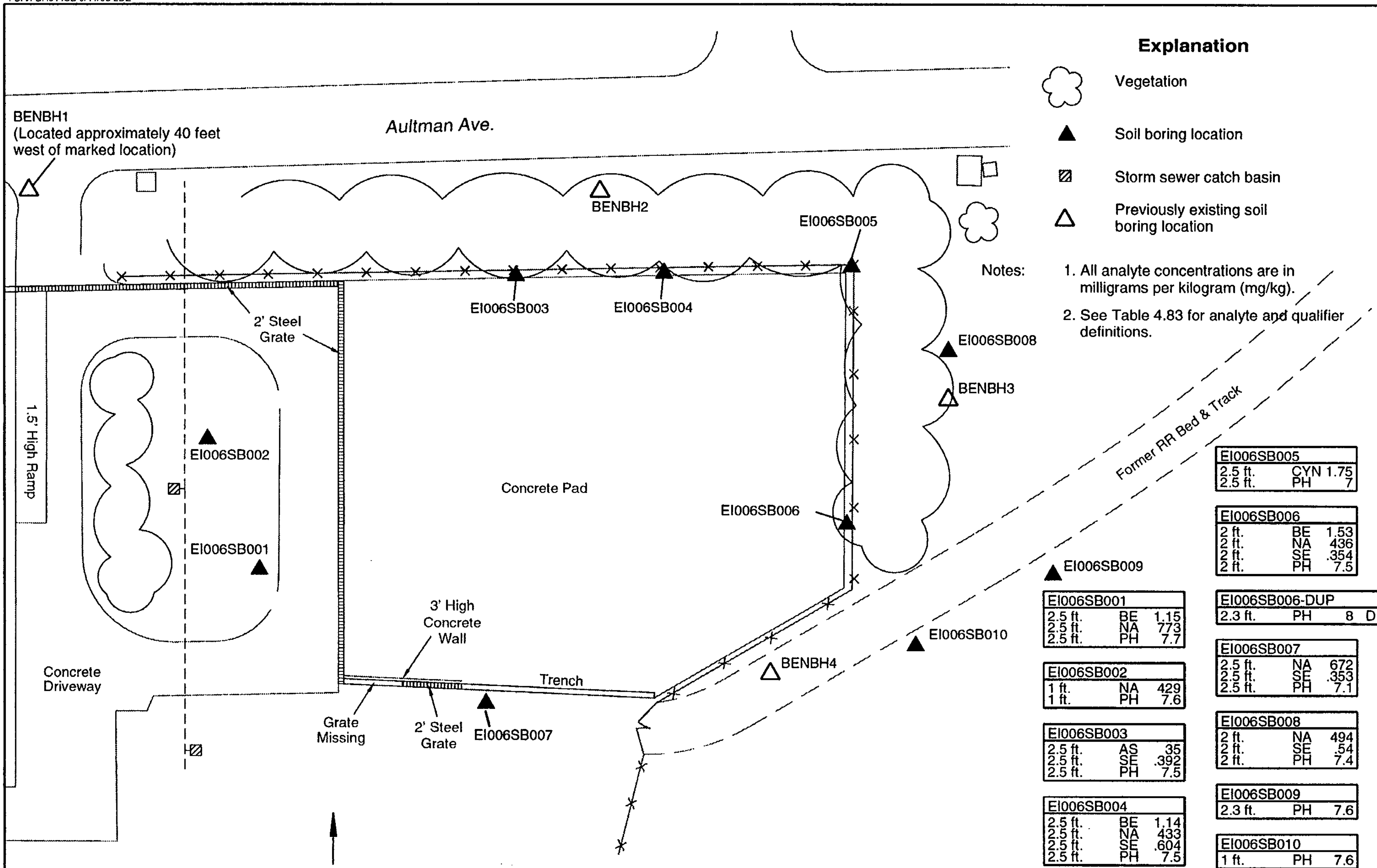

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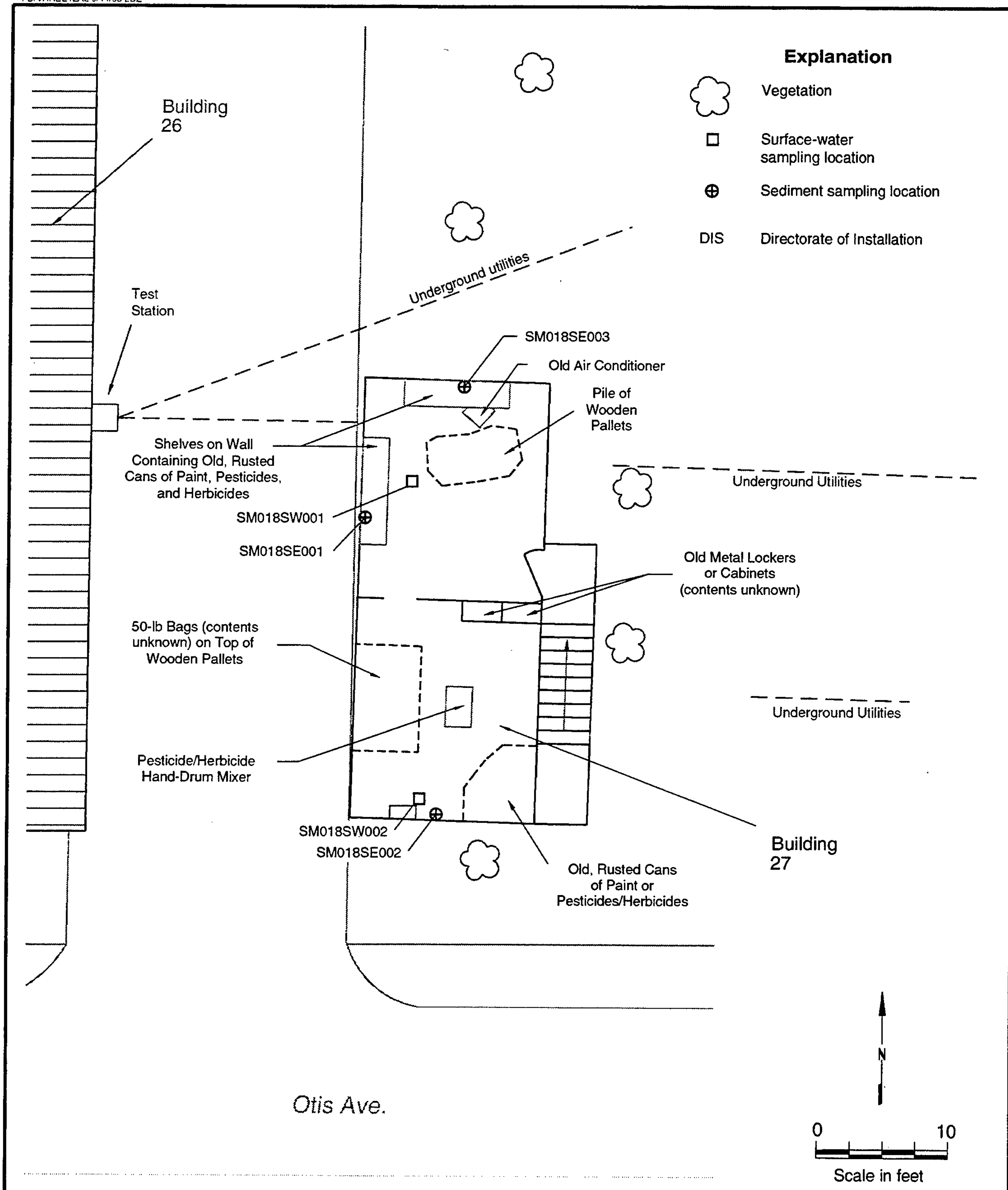
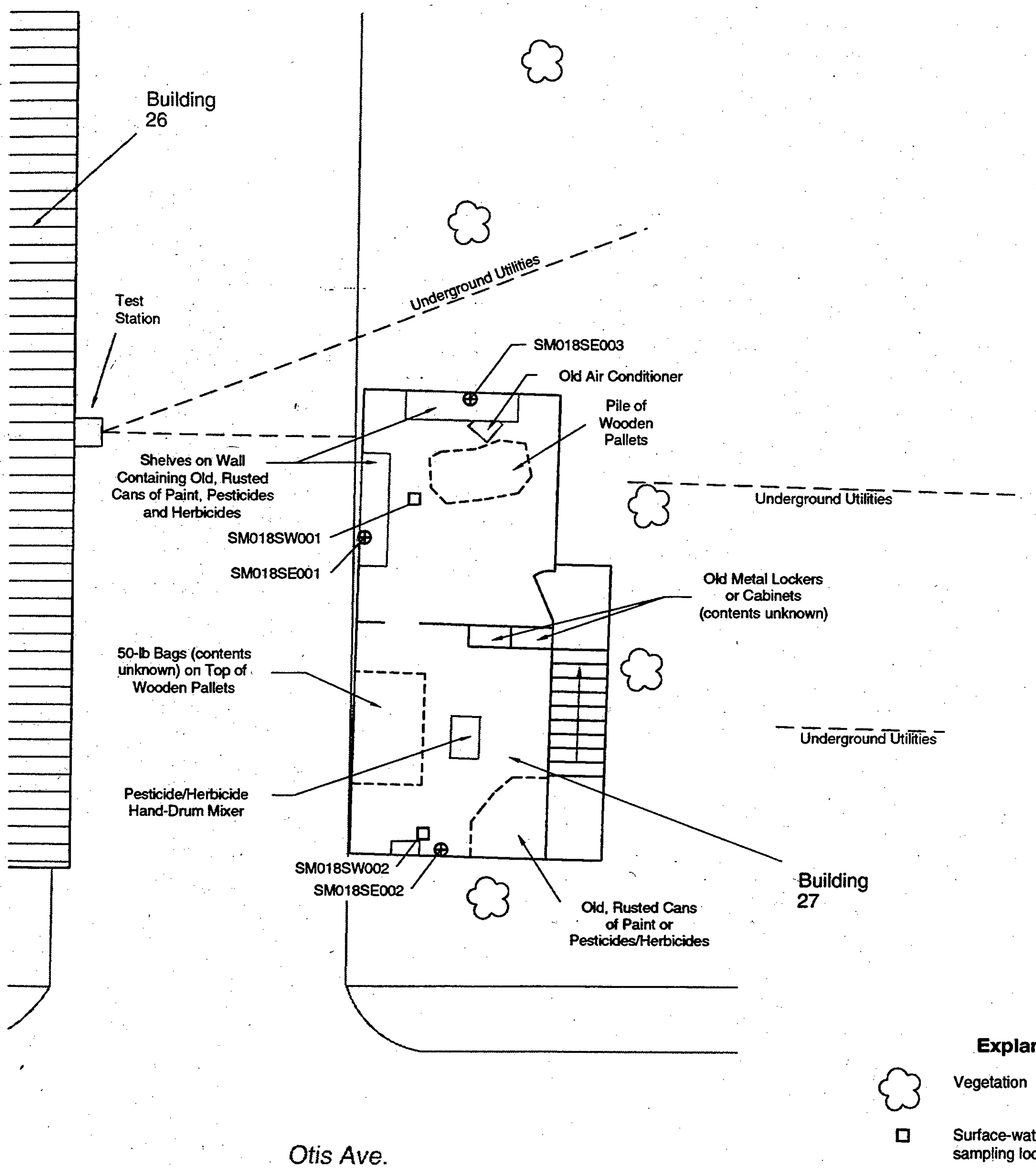
Figure 4.20

Soil Boring Sampling Results at Former Coal Storage Yard, Building 2 (EI Site 6)

FBH/AREE12A2 9/11/95 LDZ



Harding Lawson Associates Engineering and Environmental Services HLA	Prepared for: U.S. Army Environmental Center Aberdeen Proving Ground, Maryland Fort Benjamin Harrison Marion County, Indiana	Figure 4.21 Sampling Locations at Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27 (EI Site SM18)



Explanation

Vegetation

Surface-water sampling location

Sediment sampling lo

DIS Directorate of Installat

Notes: 1. All analyte concentration are in milligrams per kilog Analyte concentrations fo water are in micrograms

2. See Table 4.83 for analyt definitions.

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SM018SE001		
ACLDAN	19	Cj
ALDRN	48	Cj
DLDRN	48	Cj
GCLDAN	24	Cj
PPDDD	7.2	Cj
PPDDE	2.4	Cj
PPDDT	4.8	Cj
AS	96	j
BA	113	
CD	21.4	
CR	16.1	
CU	101	
CYN	.805	
FE	22700	
HG	3.01	
MN	289	
NA	1110	
NI	23.4	
PB	94	
SB	13.5	
SE	.867	rr
V	15.9	
ZN	5780	

SM018SE002		
ACLDAN	9.1	C
ALDRN	.23	C
DLDRN	23	C
GCLDAN	11	C
LIN	.0822	Cj
PPDDD	23	C
PPDDE	6.8	C
PPDDT	9.1	C
245T	1.8	C
24D	1.4	C
MCPP	46	C
AS	910	j
BA	196	
CD	36.5	
CO	10.7	
CR	274	
CU	212	
CYN	1.42	
FE	75300	
HG	4.43	
MN	187	
NA	1070	
NI	34.2	
PB	1230	
V	16.2	
ZN	9360	

SM018SE003		
ACLDAN	18	C
ALDRN	31	C
DLDRN	92	C
GCLDAN	25	C
HPCL	.25	C
PPDDD	9.2	Cj
PPDDE	3.1	C
PPDDT	6.1	C
AS	150	j
BA	196	
BE	3.07	
CD	19	
CO	7.67	
CR	20.6	
CU	92	
CYN	1.07	
FE	28200	
HG	4.33	
MN	583	
NA	1130	
NI	33.7	
PB	76.7	
SE	.982	rr
V	24.5	
ZN	3680	

SM018SW001		
ACLDAN	4	C
ALDRN	10	Cj
DLDRN	8	C
ENDRN	2	Crr
GCLDAN	4	C
PPDDD	3	C
PPDDE	1	C
PPDDT	1	C
245T	.19	C
24D	.1	P
AS	82.6	
AS	3.9	F
BA	47.9	
CD	8.08	
CR	10.4	
CU	134	
FE	17800	
FE	146	F
HG	.294	b
MN	19.9	F
MN	165	
NA	10400	Fj/l
NA	9730	j/l
NI	18.5	b
PB	120	
SB	3.7	Fbj
SB	4.9	b
ZN	2090	
ZN	45.5	F

SM018SW002		
ACLDAN	2	Cj
ALDRN	.29	Cj
DLDRN	6	Cj
ENDRN	1	Crr
GCLDAN	2	Cj
LIN	.4	Cj
PPDDD	10	Cj
PPDDE	3	Cj
PPDDT	3	Cj
245T	10	Cj
24D	4	C
AS	230	
AS	7.2	Fj
BA	181	
CD	40.2	
CR	13	
CU	5.38	F
CU	306	
FE	30800	
FE	115	Fb
HG	.446	b
MN	37.5	F
MN	298	
NA	43900	j/l
NA	41700	Fj/l
NI	40.5	
PB	110	
SB	10.5	
SB	6.5	Fb
V	13.8	
ZN	9240	
ZN	495	F

location

ation Support

ns for sediment
ɔgram (mg/kg).
for surface-
s per liter (ug/l).

lyte and qualifier

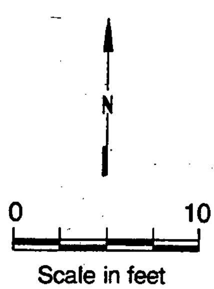

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Figure 4.22

Surface-Water and Sediment Sampling Results at Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27 (EI Site SM18)

FBH/FBH010 9/11/95 LDZ

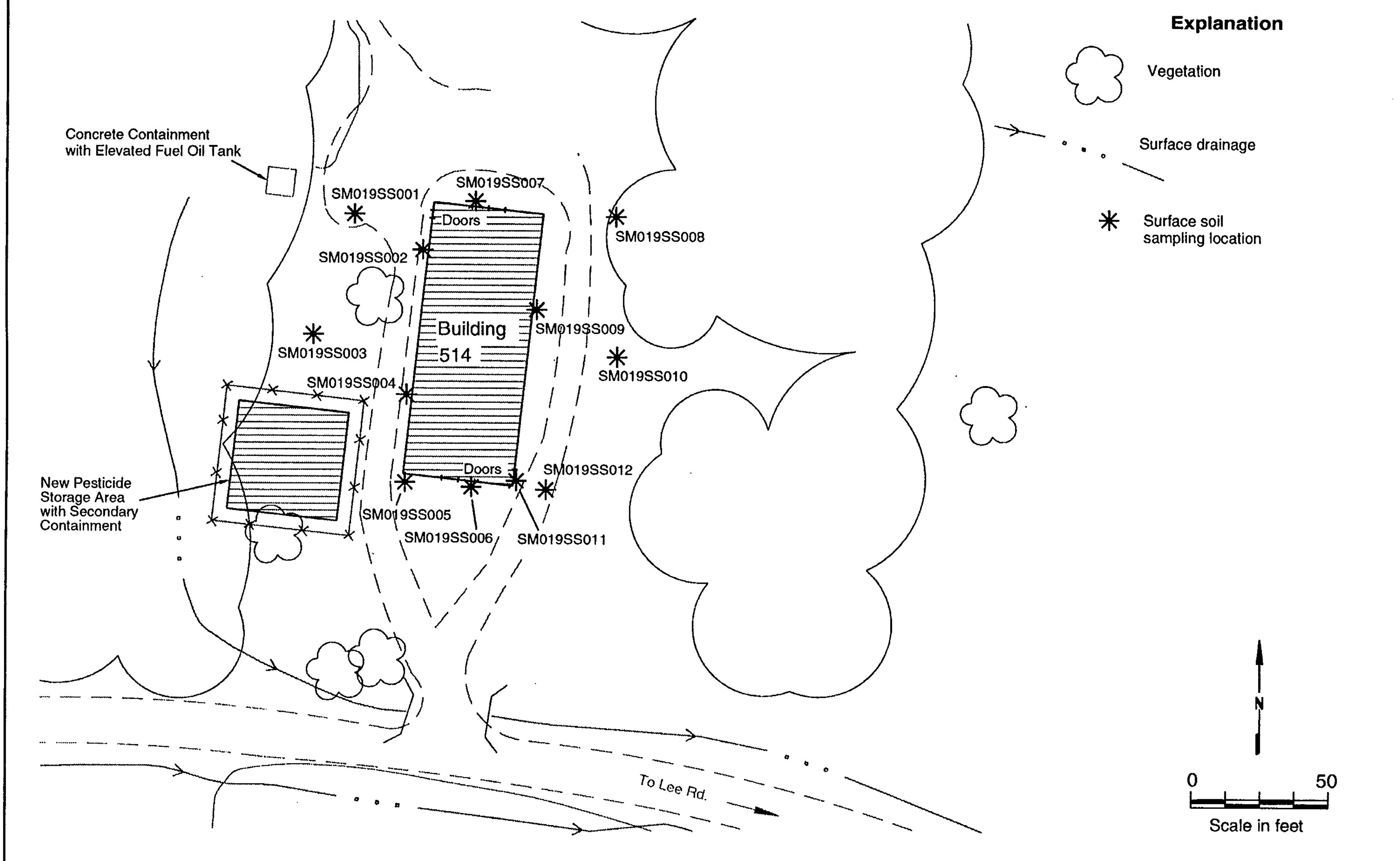

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Figure 4.23

Sampling Locations at
Pesticide Mixing and Storage Areas -
Building 514 (EI Site SM19)

SM019SS001		
ACLDAN	.00641	C
GCLDAN	.00427	C

SM019SS002		
ACLDAN	.0103	C
GCLDAN	.00601	C

SM019SS003		
ACLDAN	.0237	C
GCLDAN	.0137	C
HPCLE	.00474	C
PPDDE	.00387	C

SM019SS004		
DICP	.105	Cj

SM019SS005		
ALDRN	.0073	C
DLDRN	.0191	C
DICP	.0275	Cj

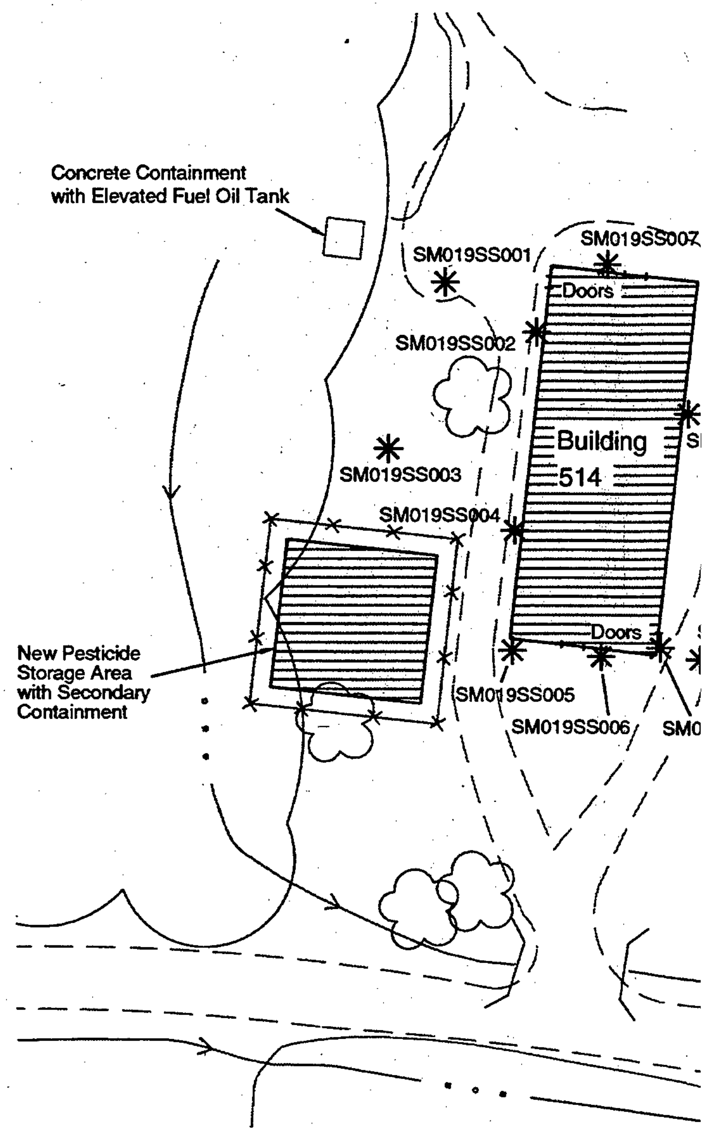
SM019SS006		
ACLDAN	.0271	C
ALDRN	.00377	C
DLDRN	.00731	C
GCLDAN	.0271	C
LIN	.00696	Cj
PPDDE	.0079	C
PPDDT	.0153	C

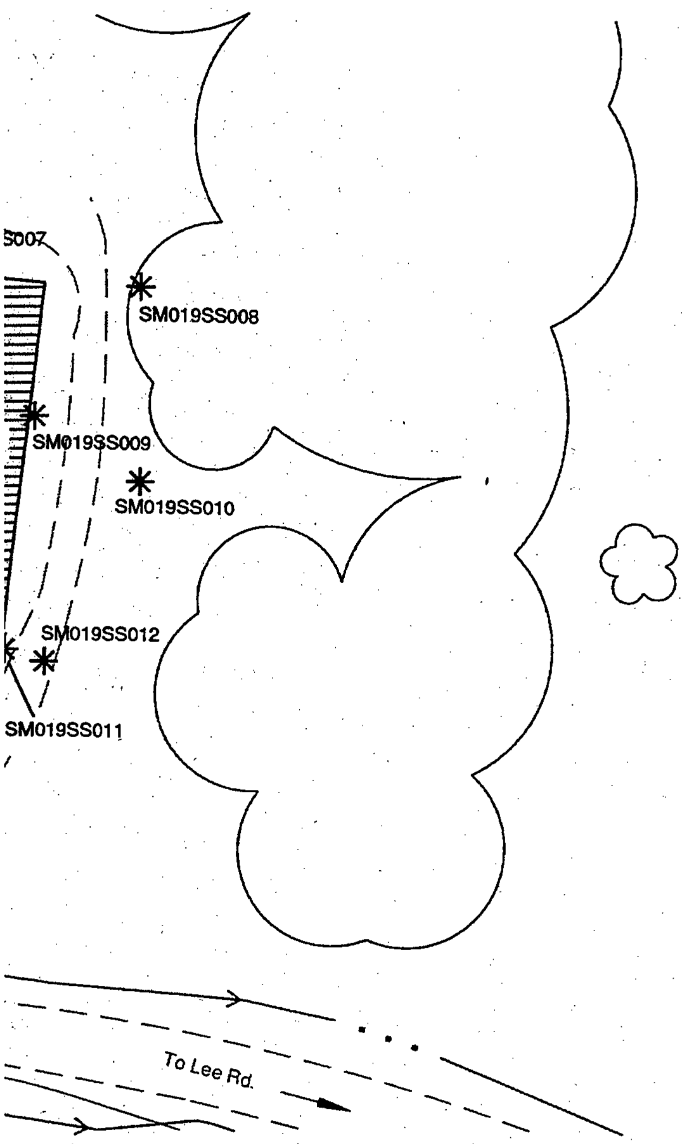
SM019SS006-DUP		
ACLDAN	.0298	C
GCLDAN	.0358	C
PPDDE	.00465	C
PPDDT	.00895	C

SM019SS007		
ACLDAN	.0762	C
DLDRN	.0121	C
GCLDAN	.0786	C
PPDDT	.01	C

SM019SS010		
ACLDAN	.00732	C
GCLDAN	.00431	C

SM019SS012		
ALDRN	.0167	Cm
PPDDE	.0552	C
PPDDT	.0629	C





Explanation

Vegetation

Surface drainage

Surface soil sampling location

Notes:

1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

N

0 50

Scale in feet

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Figure 4.24

Surface Soil Sampling Results at Pesticide Mixing and Storage Areas, Building 514 (EI Site SM19)

FBH/FBH011B 9/11/95 LDZ

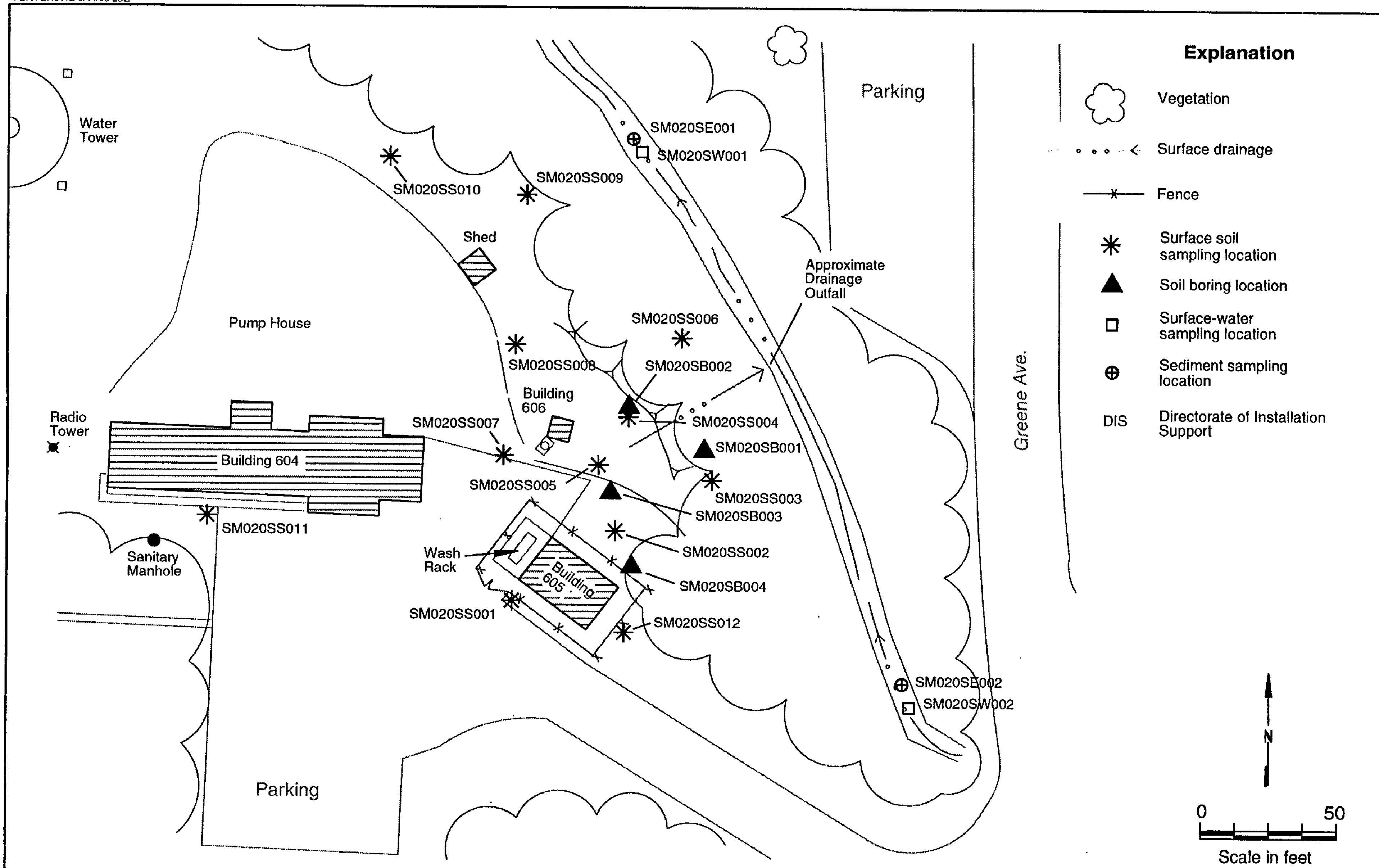

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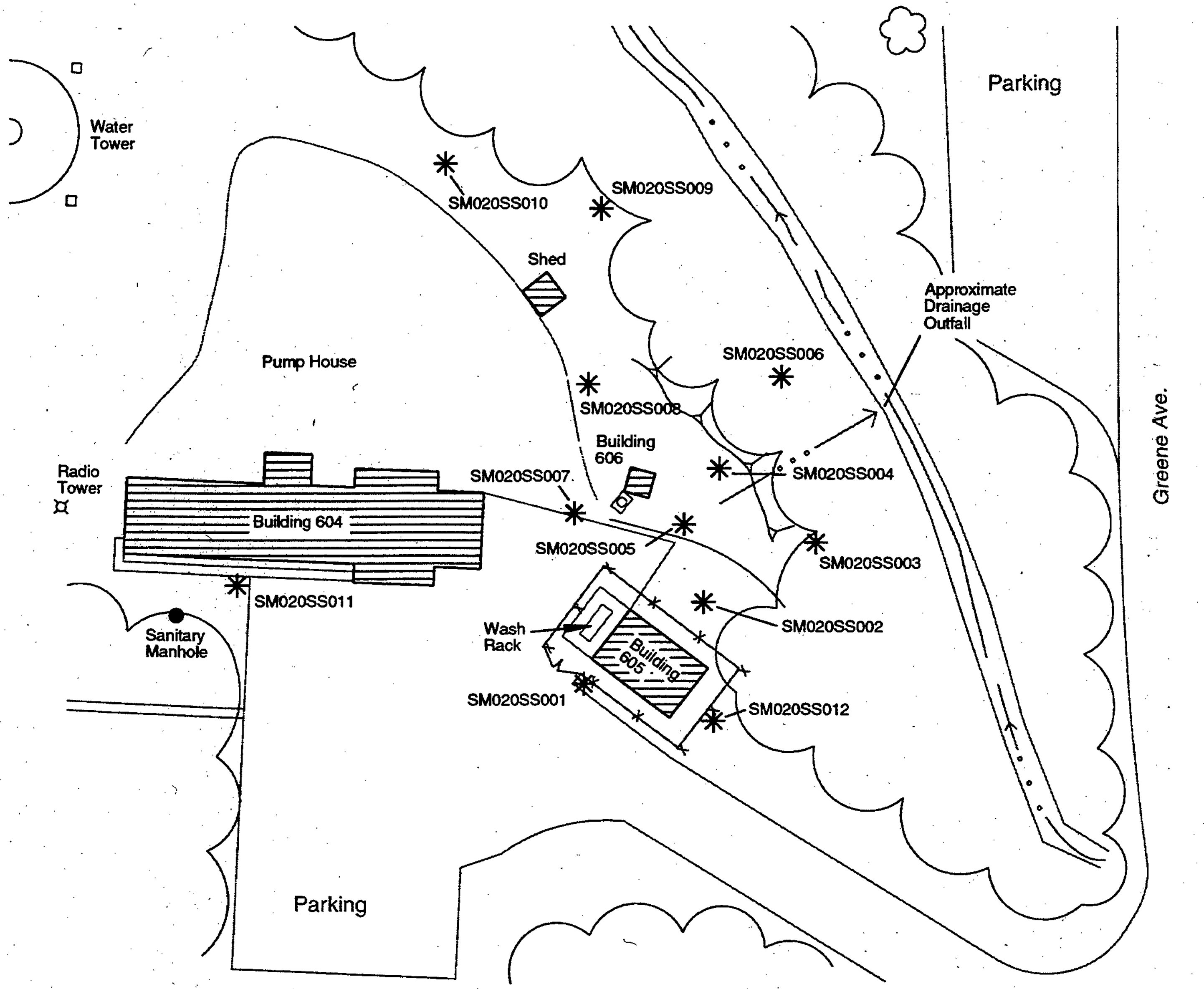
Figure 4.25
Sampling Locations at
Pesticide Mixing and Storage Areas -
DIS Entomology, Building 605
(EI Site SM20)



SM020SS001		
ACLDAN	2.7	Cj
DLDRN	.13	Cj
GCLDAN	4	Cj
MEXCLR	.0547	Cj
PCB260	1.3	Cj
PPDDE	.4	Crr
PPDDT	.4	Cj
24D	.53	C
DCAMBA	.0333	C

SM020SS002		
ACLDAN	.00803	Cj
DLDRN	.97	Cj
ENDRN	.0158	Cj
GCLDAN	.00657	Crr
PCB260	.0523	Cj
PPDDD	.017	Cj
PPDDE	.12	Cj
PPDDT	.12	Cj

SM020SS003		
ACLDAN	.0277	Cj
DLDRN	.13	Cj
ENDRN	.0224	Cj
GCLDAN	.0356	Cj
PCB260	.26	Cj
PPDDE	.13	Cj
PPDDT	.79	Cj

SM020SS004		
DLDRN	.12	Cj
GCLDAN	.0207	Crr
PCB260	2.4	Cj
PPDDD	.12	Crr
PPDDE	.49	Cj
PPDDT	.85	Cj

SM020SS005		
ACLDAN	.00483	Cj
DLDRN	.0718	Cj
GCLDAN	.0186	Crr
PCB260	2.5	Cj
PPDDD	.25	Cj
PPDDE	.87	Cj
PPDDT	.99	Cj
24D	.0173	C

SM020SS007		
ACLDAN	.0119	Cj
DLDRN	.0119	Cj
ENDRN	.00765	Crr
GCLDAN	.0194	Cj
PCB260	.43	Cj
PPDDD	.0259	Cj
PPDDE	.0614	Cj
PPDDT	.11	Cj
24D	.014	C

SM020SS008		
DLDRN	.0096	Cj
GCLDAN	.00396	Crr
PCB260	.0984	Cj
PPDDD	.0684	Cj
PPDDE	.36	Cj
PPDDT	.24	Cj

SM020SS009		
PCB260	.0461	Cj
PPDDD	.0697	Crr
PPDDE	.47	C
PPDDT	.71	Cj

SM020SS010		
DLDRN	.0148	C
ENDRN	.00605	Cr
PPDDE	5.7	C
PPDDT	6.8	C

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SM020SS005-DUP		
DLDRN	.0297	DC
PCB260	.95	DCj
PPDDD	.0155	DCj
PPDDE	.48	DC
PPDDT	.48	DCj
24D	.0202	C

SM020SS006		
DLDRN	.0227	Cj
PCB260	.122	Cj
PPDDD	.0283	Cj
PPDDE	.0907	Cj
PPDDT	.0907	Cj

SM020SS011		
DLDRN	.004	C
PPDDD	.0327	Cj
PPDDE	.12	C
PPDDT	.0739	C

SM020SS012		
DLDRN	.0297	Cj
PPDDD	.0644	Cj
PPDDE	.12	Cj
PPDDT	.5	Cj

Explanation

Vegetation

Surface drainage

Fence

Surface soil sampling location

DIS Directorate of Installation Support

Notes: 1. All analyte concentrations are in milligrams per kilogram (mg/kg).

2. See Table 4.83 for analyte and qualifier definitions.

N

0 50

Scale in feet

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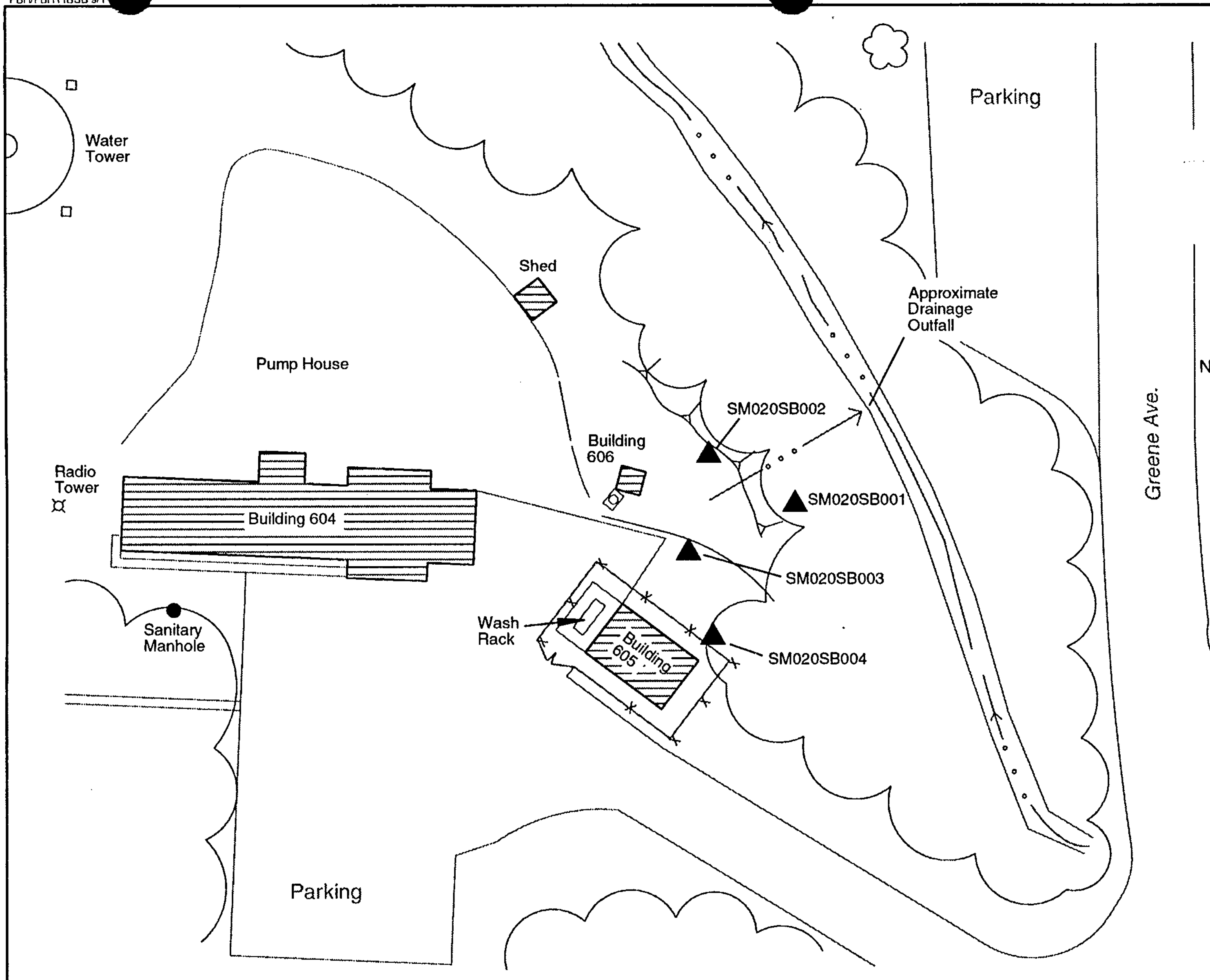
Figure 4.26

Surface Soil Sampling Results at Pesticide Mixing and Storage Areas - DIS Entomology, Building 605 (EI Site SM20)

FBH/FBH11BSB 9/1



Explanation

Vegetation

Surface drainage

Fence

Soil boring location

DIS Directorate of Installation Support

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

SM020SB002-DUP			
3 ft.	PPDDT	.00383	C

SM020SB003			
3 ft.	ACLDAN	.0216	C
3 ft.	DLDRN	.00511	C
3 ft.	GCLDAN	.0238	C
3 ft.	PCB260	.0193	C
3 ft.	PPDDE	.00795	C
3 ft.	PPDDT	.0272	C

N

0 50
Scale in feet

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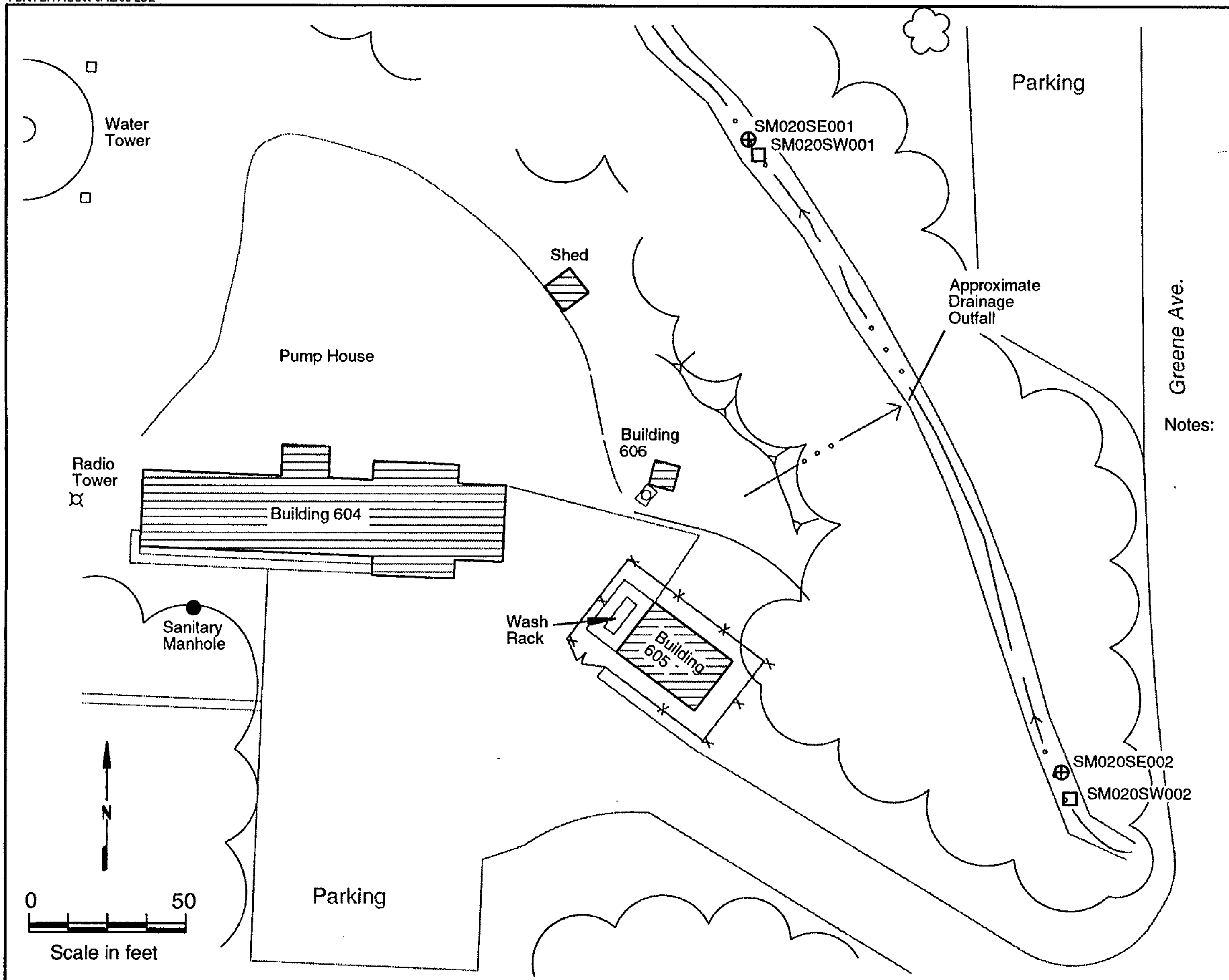
Figure 4.27
Soil Boring Sampling Results at Pesticide Mixing and Storage Areas - DIS Entomology, Building 605 (EI Site SM20)

FBH/FBH11BSW 9/12/95 LDZ



Explanation

- Vegetation
- Surface drainage
- Fence
- Surface-water sampling location
- Sediment sampling location
- DIS — Directorate of Installation Support

Notes:

1. All analyte concentrations for sediment are in milligrams per kilogram (mg/kg). Analyte concentrations for surface water are in micrograms per liter (ug/l).
2. See Table 4.83 for analyte and qualifier definitions.

SM020SW001		
24D	.43	C

SM020SW001-DUP		
24D	.37	C

SM020SE001		
DLDRN	.0093	C
GCLDAN	.00388	CJPb
PPDDT	.00866	C

SM020SE002		
DLDRN	.00775	Crr

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Figure 4.28

Surface-Water and Sediment Sampling Results at Pesticide Mixing and Storage Areas, DIS Entomology, Building 605 (EI Site SM20)

FBH/FBH012 9/11/95 LDZ

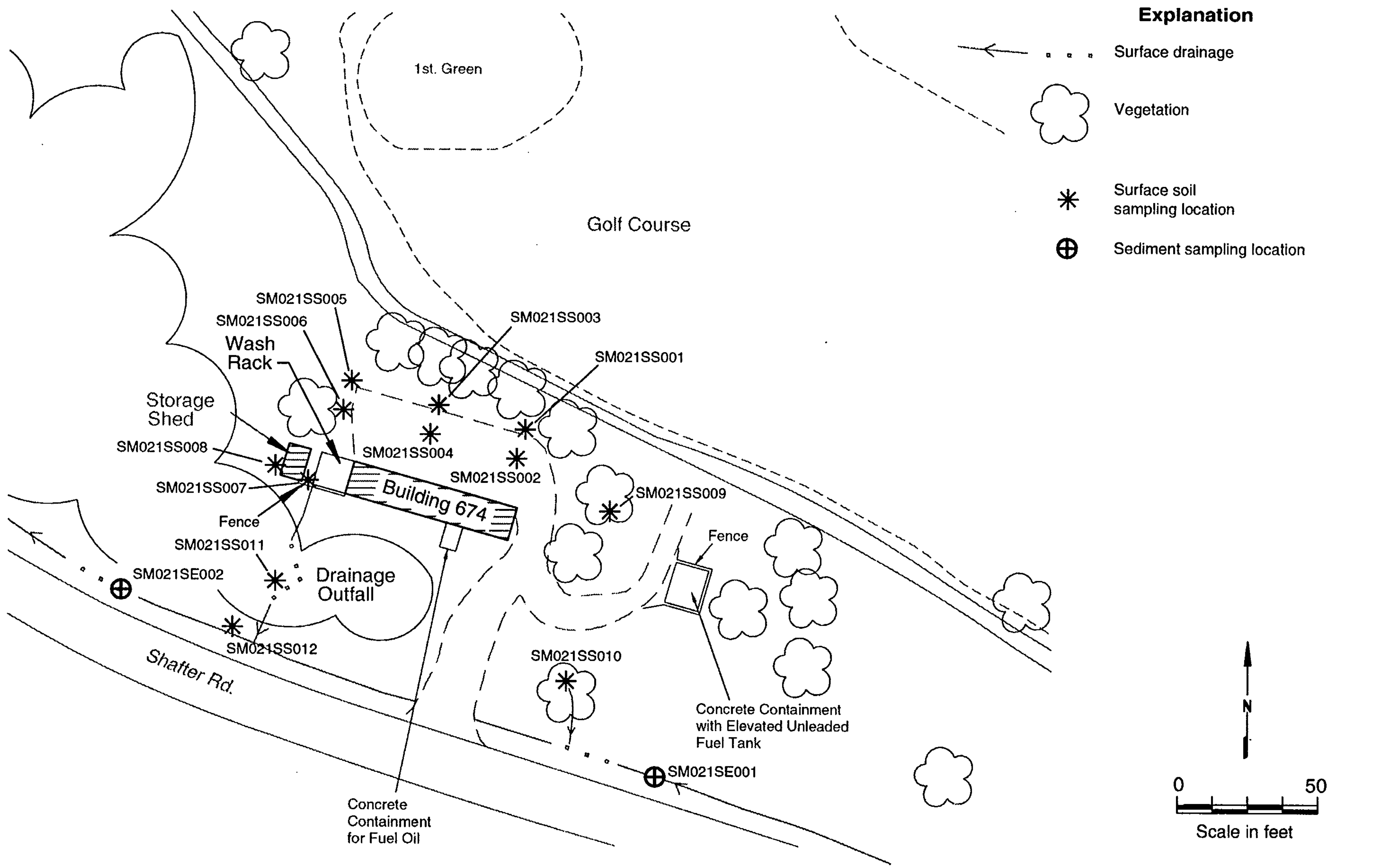

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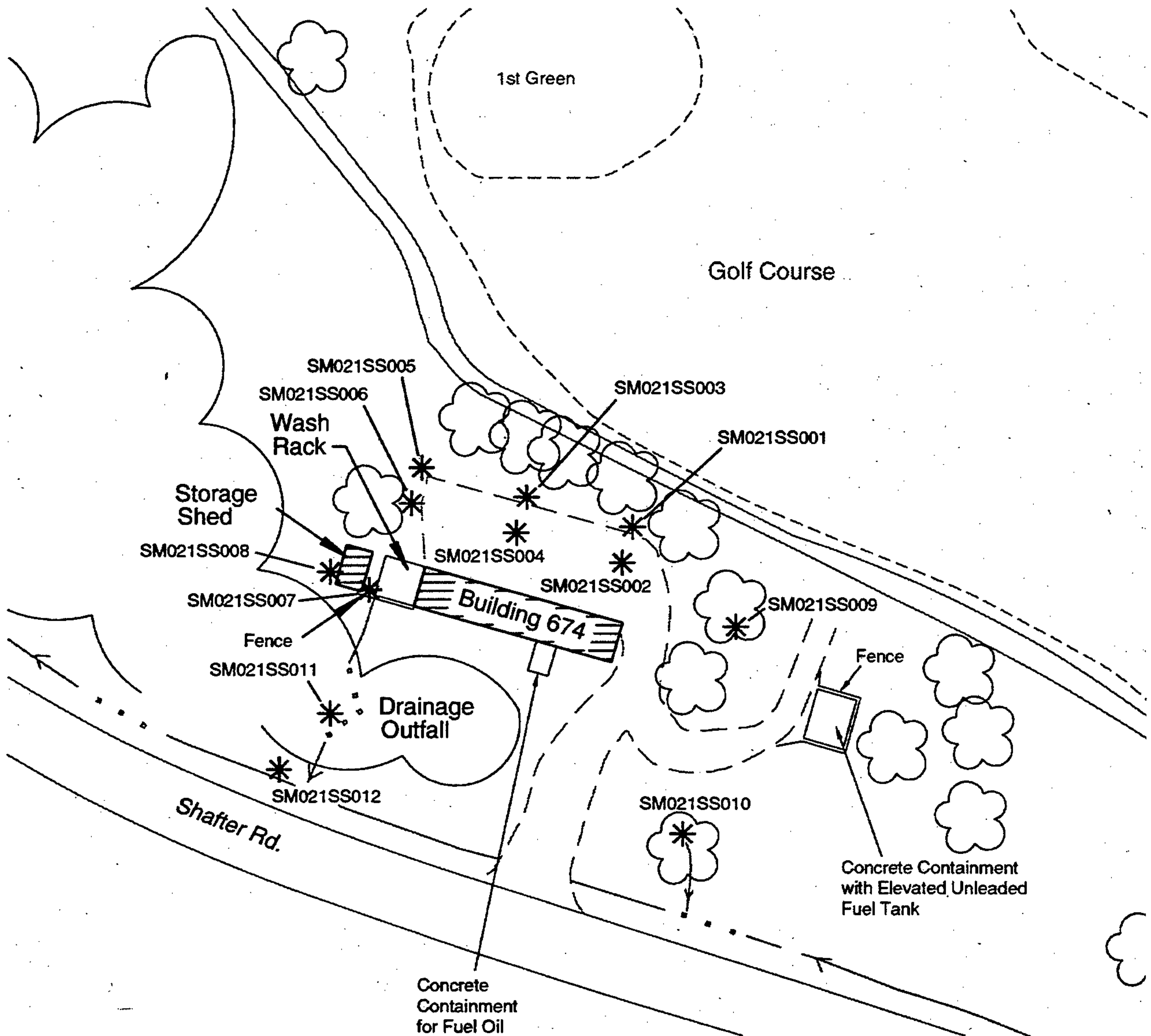
Figure 4.29

Sampling Locations at Pesticide Mixing and Storage Areas, Building 674 (EI Site SM21)



SM021SS001		
ACLDAN	1.5	C
GCLDAN	1.2	C
HPCL	.0195	C
HPCLE	.12	C

SM021SS002		
ACLDAN	2.2	C
GCLDAN	2.8	C
HPCL	.11	Crr

SM021SS003		
ACLDAN	.27	C
GCLDAN	.27	C
HPCLE	.0226	C
PPDDE	.0345	Crr
24D	.0305	C

SM021SS003-DUP	
ACLDAN	.5
DLDRN	.015
GCLDAN	.5
HPCLE	.023
PPDDT	.030

SM021SS006		
ACLDAN	.07	C
GCLDAN	.093	C
PPDDE	.00465	C
24D	.036	C

SM021SS007		
ACLDAN	.19	C
GCLDAN	.19	C
HPCLE	.0107	C
PPDDD	.00606	C
PPDDE	.0136	C

SM021SS008		
ACLDAN	.096	C
DLDRN	.00502	C
GCLDAN	.072	C
HPCLE	.00646	C

SM021SS009	
ACLDAN	.(
DLDRN	.005
GCLDAN	.(
HPCLE	.01
PPDDE	.005

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Environmental Services

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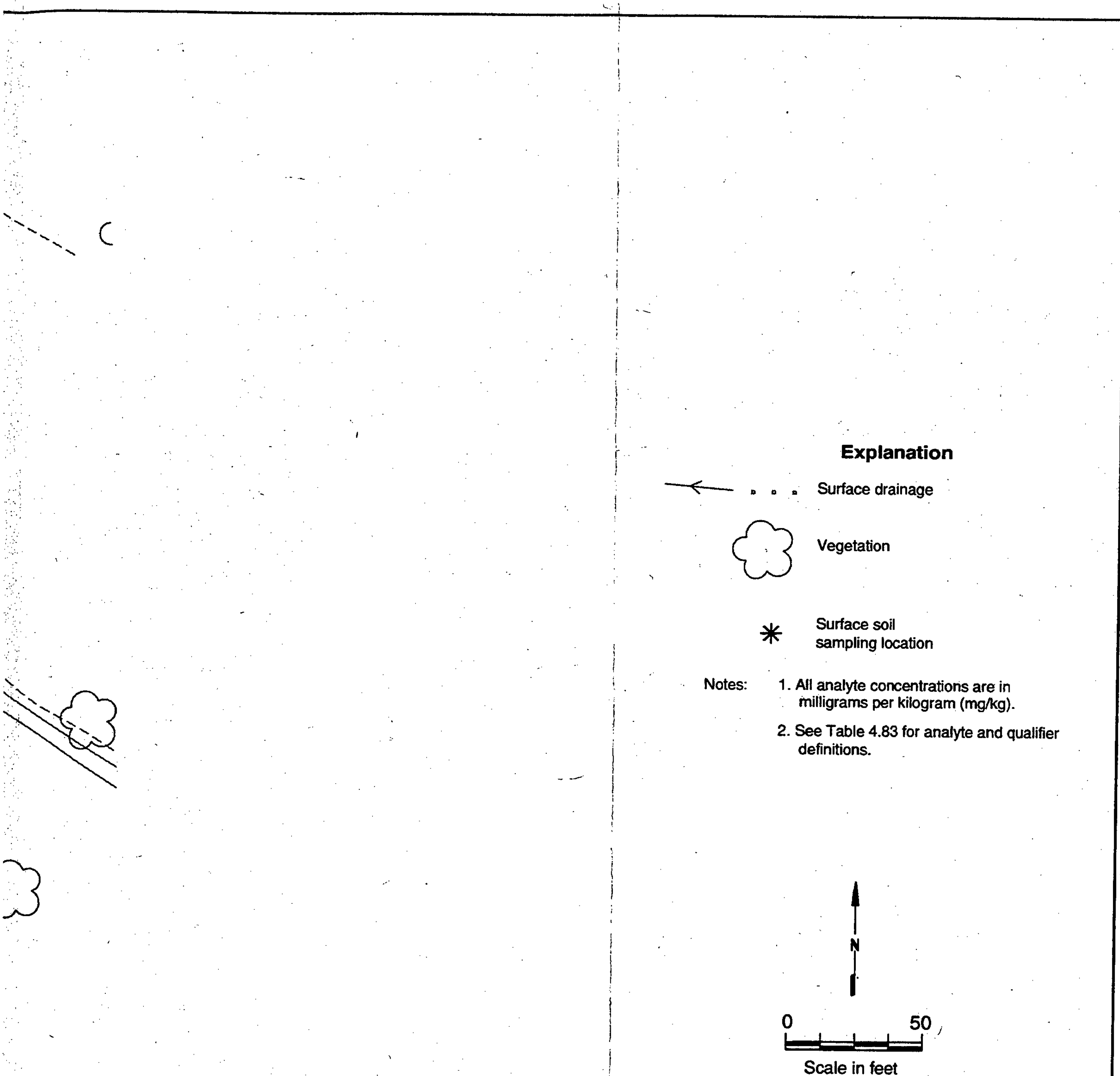

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

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Figure 4.30

Surface Soil Sampling Results at Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, Building 674 (EI Site SM21)

FBH/FBH012SD 9/11/95 LDZ

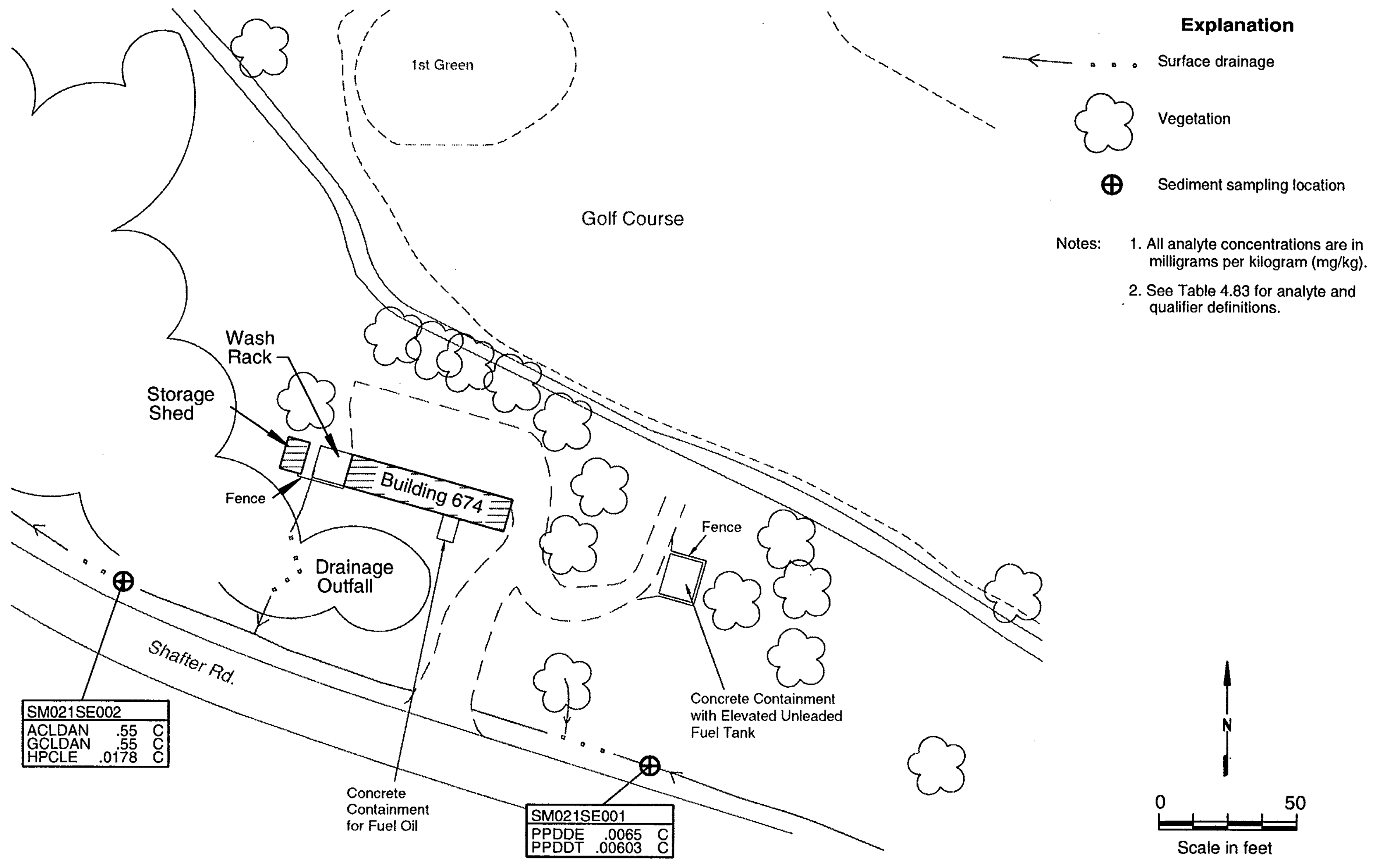

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Figure 4.31

Sediment Sampling Results at Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, Building 674 (EI Site SM21)

FBH/FBH006 9/11/95 LOZ

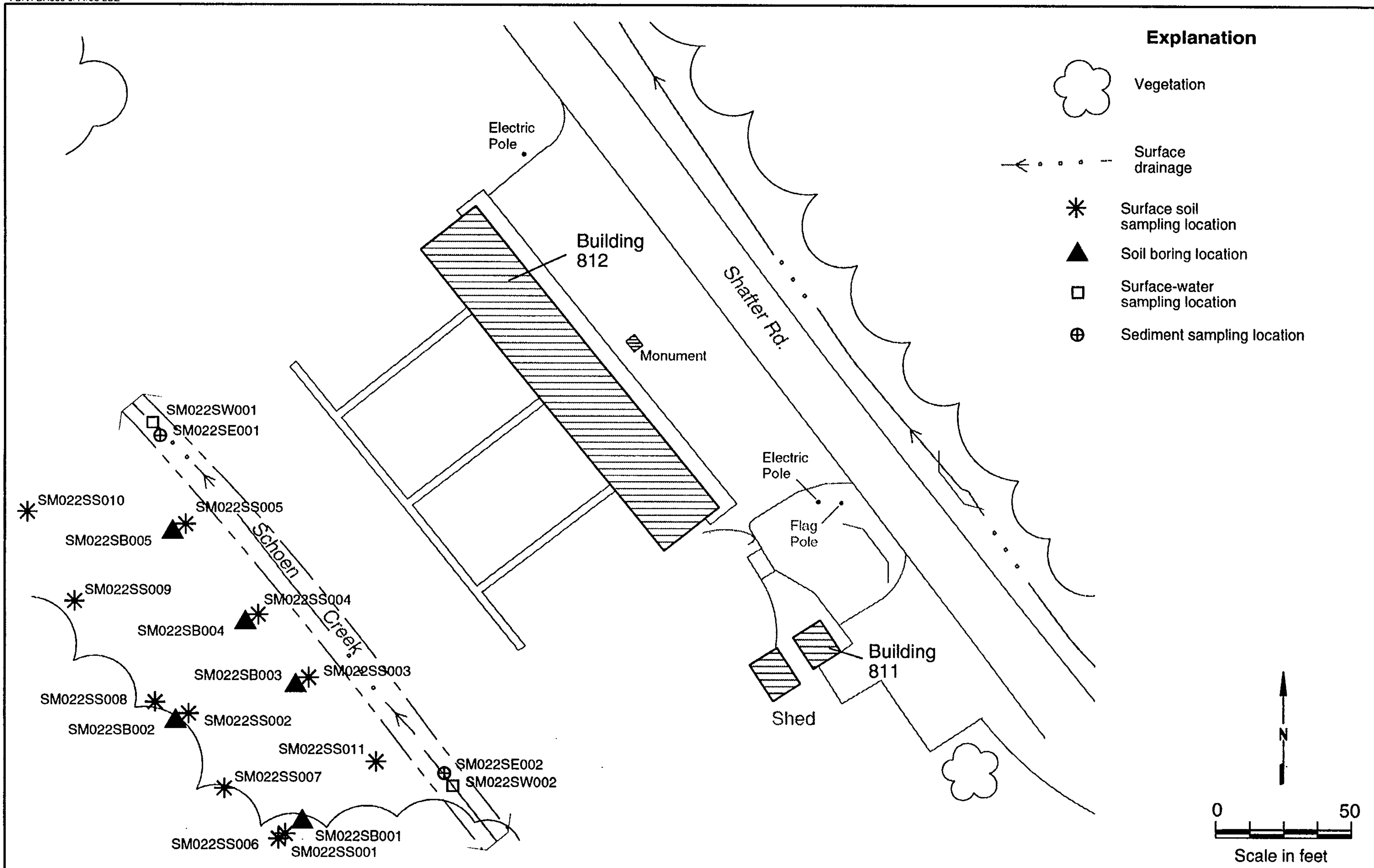

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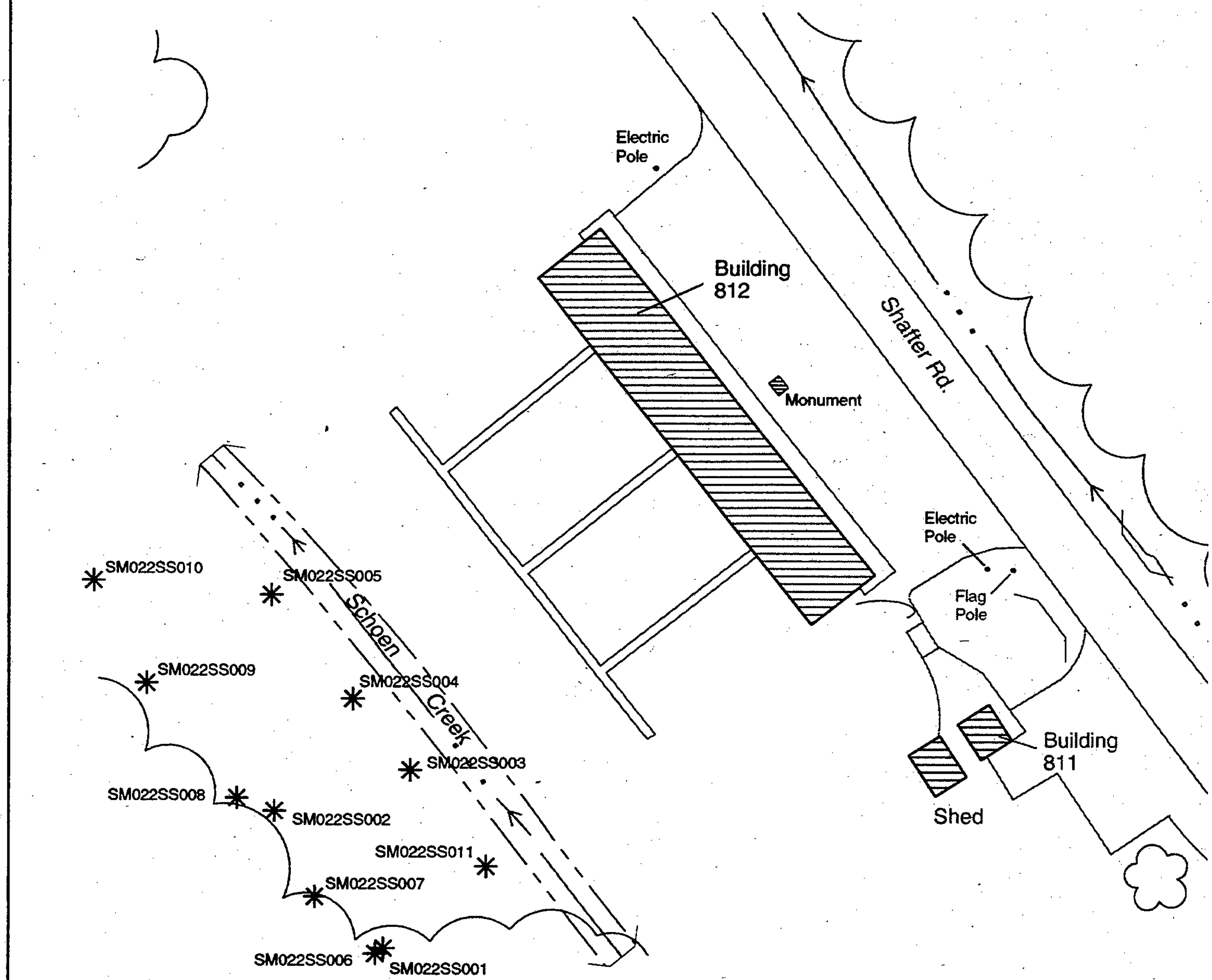
Figure 4.32

Sampling Locations at
Foreman Rifle Range, Near Buildings
811 and 812 (EI Site SM22)

FBH/FBH006SS 9/11/95 LDZ



SM022SS001		
AS	13	j
CU	95.1	j
PB	9890	
SB	100	

SM022SS002		
AG	1.34	
AS	24	j
CU	535	j
PB	36000	
SB	583	
ZN	134	

SM022SS003		
AS	9.4	j
CU	118	j
PB	1060	
SB	11.8	
ZN	85	

SM022SS004		
AG	.637	P
AS	7.6	j
CU	98.1	j
PB	25000	
SB	255	
ZN	84.1	

SM022SS007		
AS	8.83	j
CU	128	j
PB	5340	
SB	45.3	

SM022SS008		
AG	1.85	
AS	31	j
CU	3090	j
PB	49000	
SB	543	
TL	13.6	
ZN	395	

SM022SS009		
AS	24	j
CU	872	j
CYN	.381	
PB	6210	
SB	56.2	
ZN	143	

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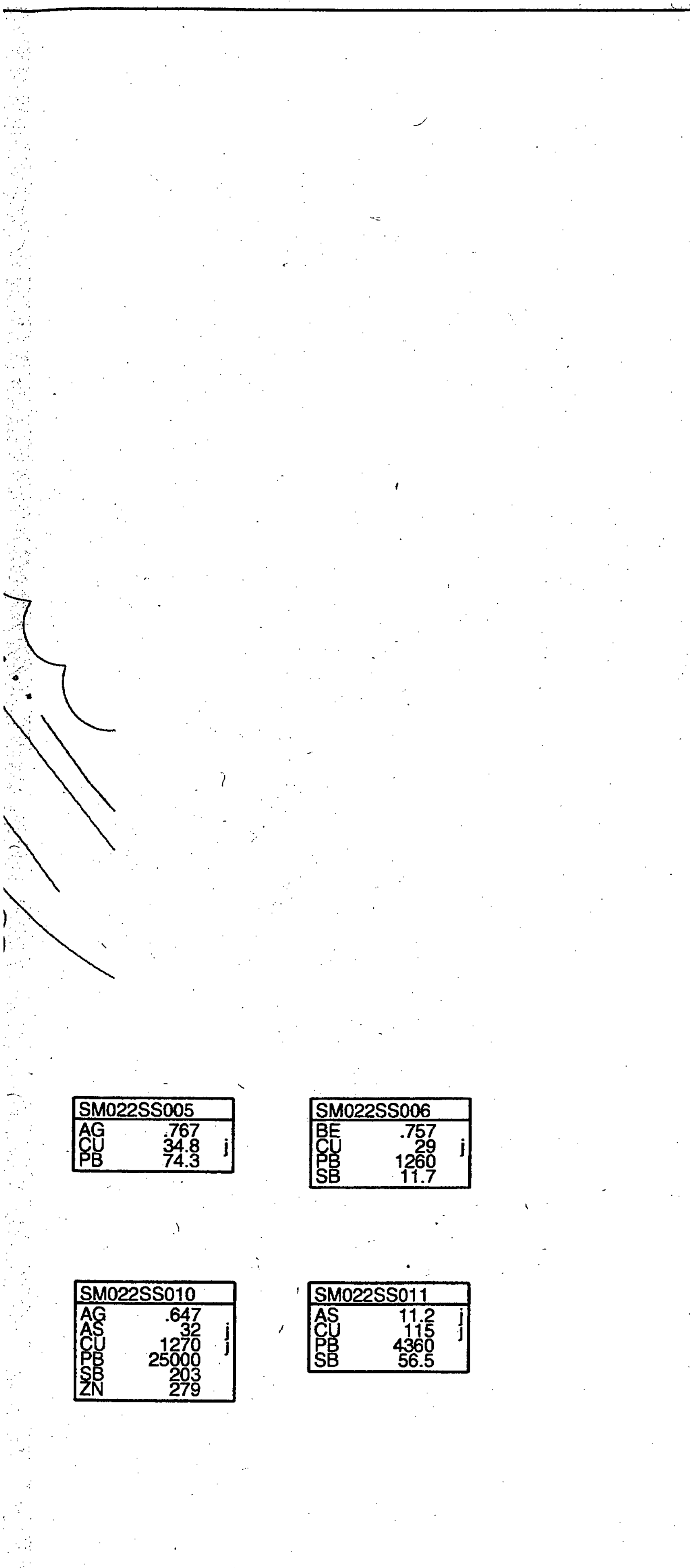

Explanation

Vegetation

Surface drainage

Surface soil sampling location

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

N

0 50

Scale in feet

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Marion County, Indiana

Figure 4.33

Surface Soil Sampling Results at Foreman Rifle Range, Near Buildings 811 and 812 (EI Site SM22)

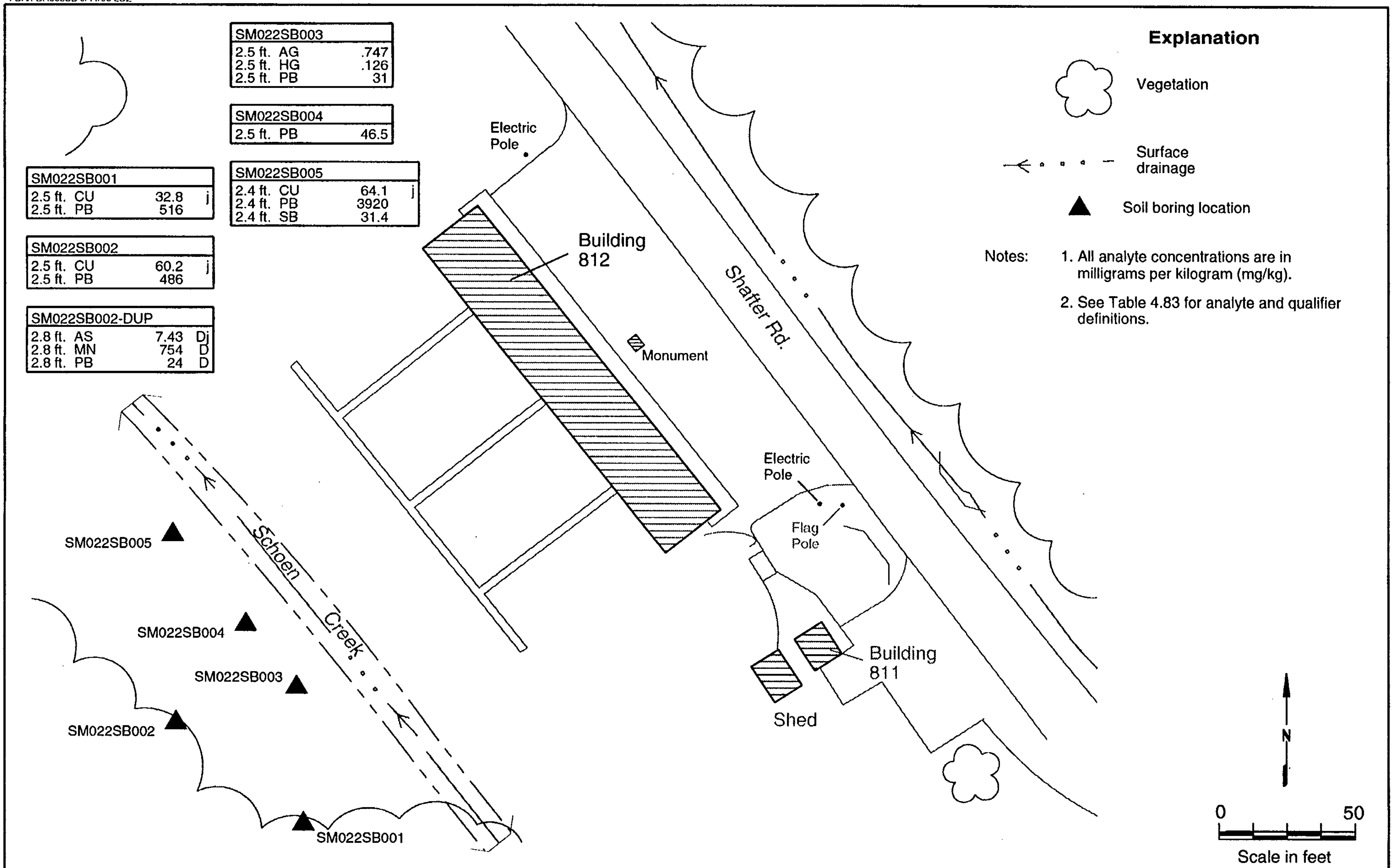

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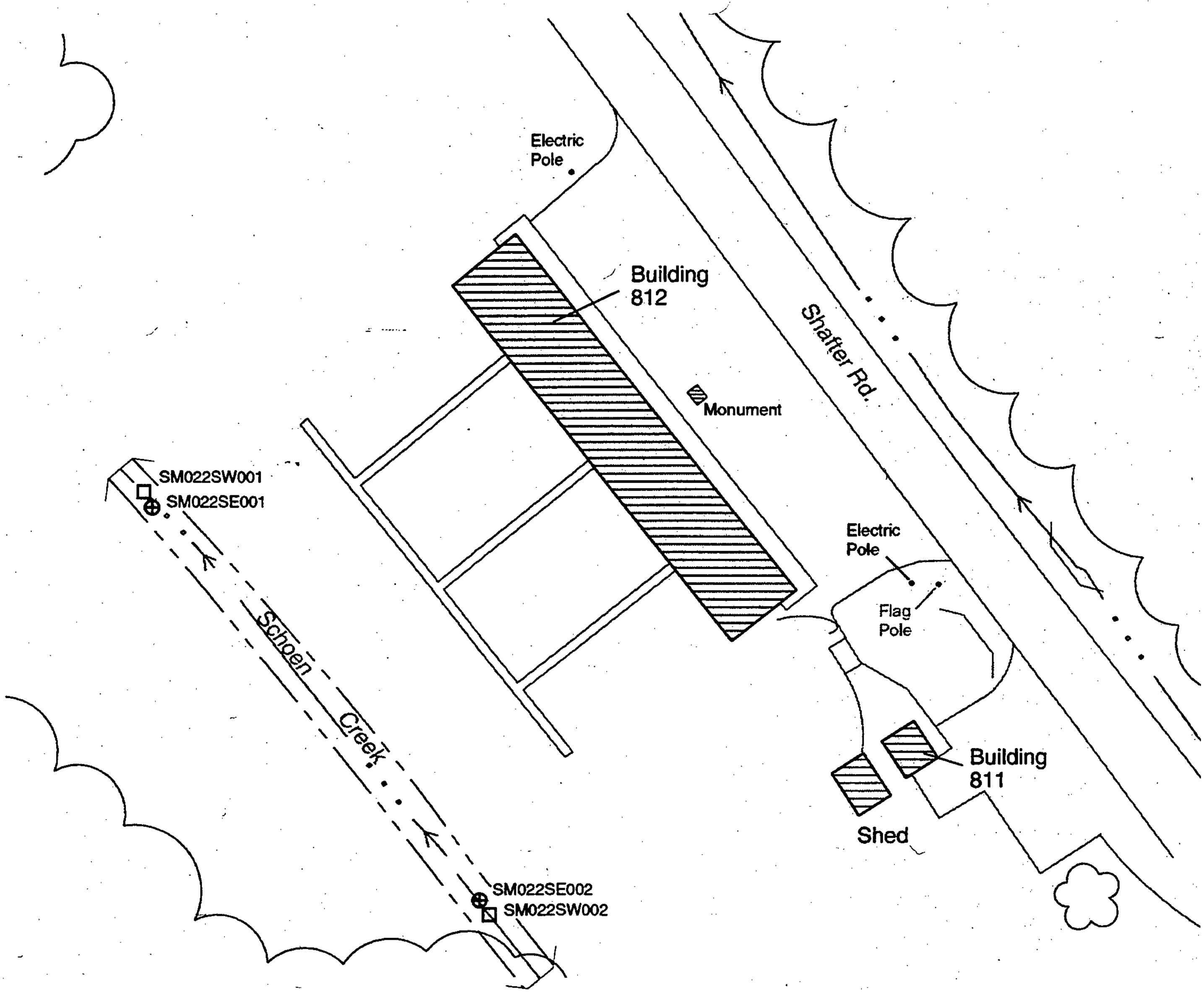
Figure 4.34

Soil Boring Sampling Results at Foreman Rifle Range, Near Buildings 811 and 812 (EI Site SM22)



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SM022SW001		
BA	60.8	F
BA	62.1	
CU	6.36	
FE	53.5	Fj
FE	458	j
MN	45.5	
MN	35.1	F
NA	94700	/I
NA	96800	F/I
PB	3	
SB	5.2	Frr

SM022SW002		
BA	58.3	F
BA	74.8	
CU	11.4	
FE	1720	j
MN	32.4	F
MN	102	
NA	93300	/I
NA	95000	F/I
SB	5.2	Frr
ZN	20.3	

SM022SE001		
AS	9.42	j
BA	84.2	
CO	7.01	
CR	15.2	
CU	80.2	
FE	16800	
MN	962	
NA	822	
NI	19.8	
PB	361	
V	20	
ZN	144	

SM022SE002		
AS	4.21	j
CO	4.21	
CR	9.56	
CU	22.9	
FE	10900	
MN	363	
NA	707	
NI	11.9	
PB	24.9	
V	14.3	
ZN	59.3	

Explanation

Vegetation

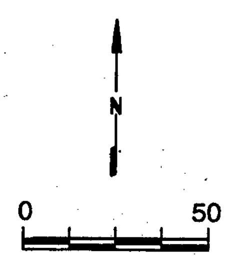
Surface drainage

Surface-water sampling location

Sediment sampling location

Notes:

1. All analyte concentrations for sediment are in milligrams per kilogram (mg/kg). Analyte concentrations for surface water are in micrograms per liter (ug/l).
2. See Table 4.83 for analyte and qualifier definitions.



Scale in feet

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Marion County, Indiana

Figure 4.35

Surface-Water and Sediment Sampling Results at Foreman Rifle Range, Near Buildings 811 and 812 (EI Site SM22)

FBH/FBH007 8/28/95 LDZ

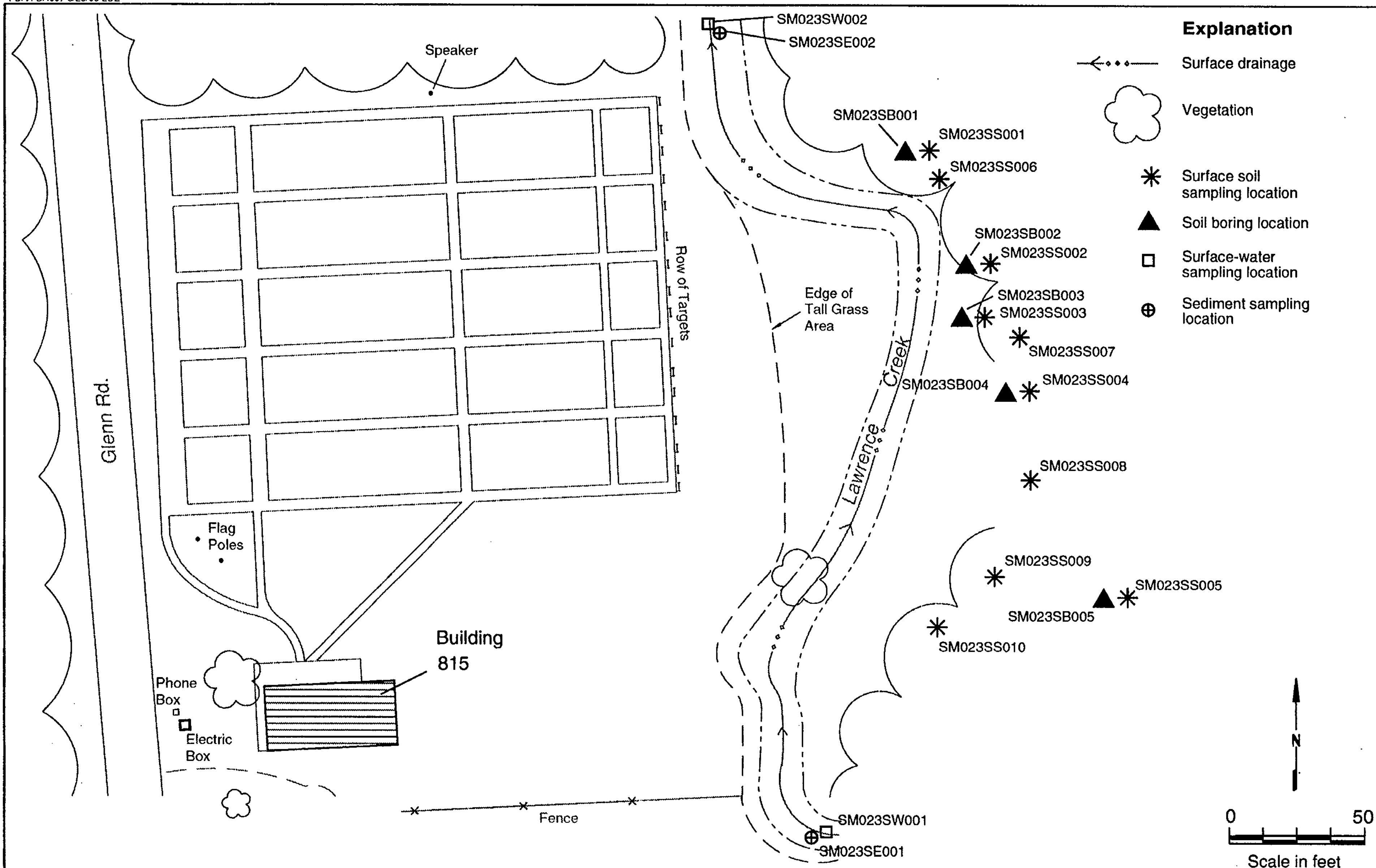

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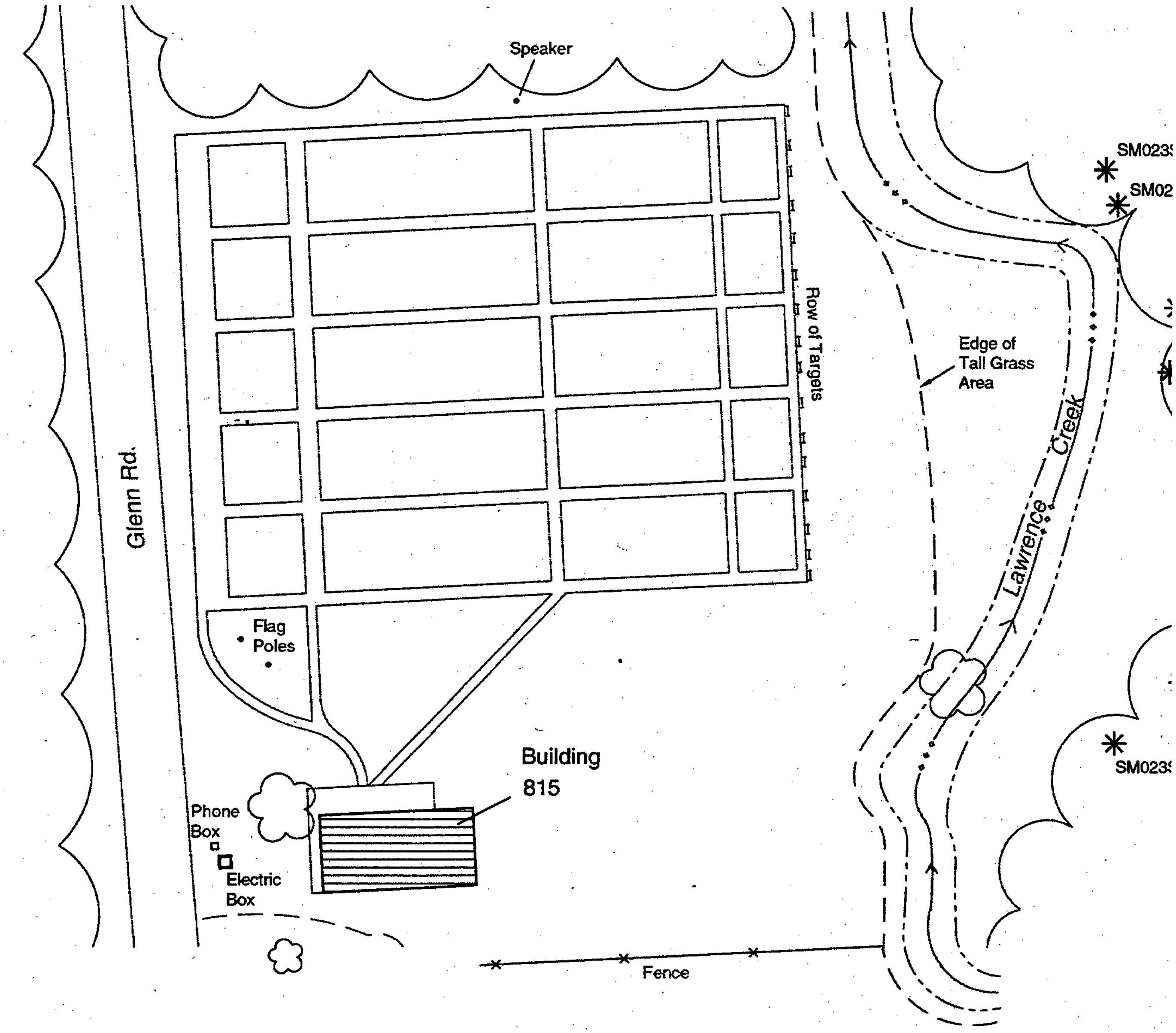
Figure 4.36

Sampling Locations at
State Police Pistol Range,
Near Building 815 (EI Site SM23)



SM023SS001		
AG	5.16	j
AS	14	j/l
CU	180	j
NI	32.4	j
PB	96000	j
SB	684	
TL	100	j

SM023SS002		
CU	45.3	j
PB	3100	j
SB	23.9	
TL	27.4	j

SM023SS003		
AS	8.9	j/l
CU	24.5	j
PB	523	j
SB	10	
TL	21.1	j

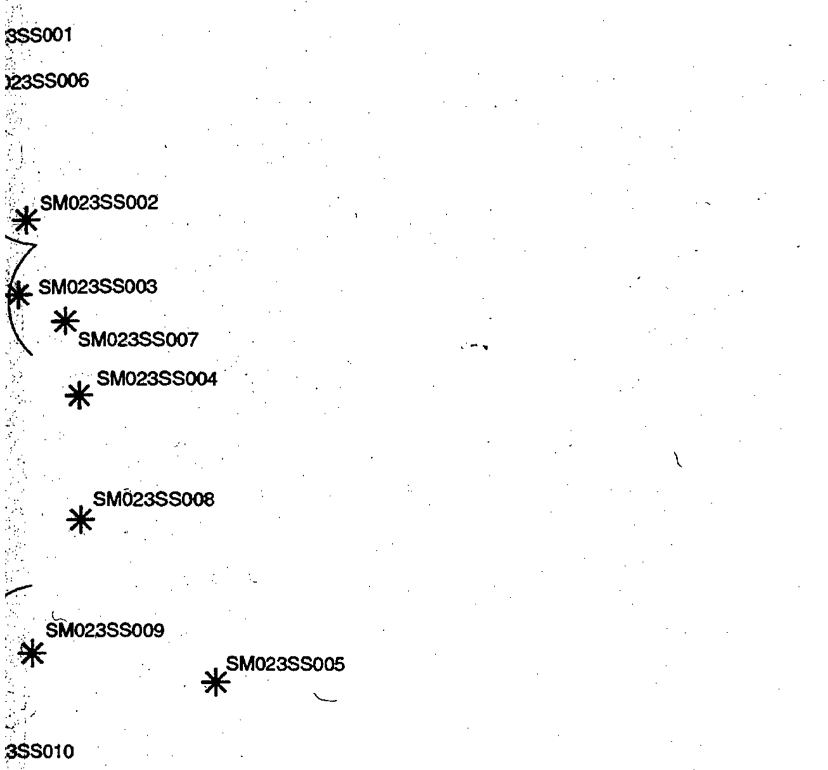
SM023SS(
AG
AS
CU
PB
SB
TL

SM023SS006		
CU	54.8	j
PB	37000	j
SB	524	
TL	100	j

SM023SS007		
AS	46	j/l
CU	26.6	j
PB	2660	j
SB	18.5	
TL	28.9	j

SM023SS008		
AG	1.36	j
AS	11	j/l
CU	261	j
PB	68000	j
SB	488	
TL	100	j

SM023
AS
CO
CU
NI
PB
SB
TL



S004		
	2.09	j
	15	j/l
	165	j
	99000	j
	1540	
	100	j

SM023SS005		
AS	19	j/l
CU	55.5	j
NA	785	
PB	798	j
SB	12.3	
TL	28.4	j

SM023SS005-DUP		
AS	700	Dj/l
CU	60.1	Dj
NA	448	D
PB	1680	Dj
SB	32.2	D
TL	28	Dj

23SS009		
	24	j/l
	10.7	
	91.2	j
	33.5	j
	1740	j
	13.4	
	20.1	j

SM023SS010		
AS	7.7	j/l
CU	20.6	j
NA	412	
PB	180	j
TL	32.2	j

Explanation

Surface drainage

Vegetation

Surface soil sampling location

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

N

0 50

Scale in feet

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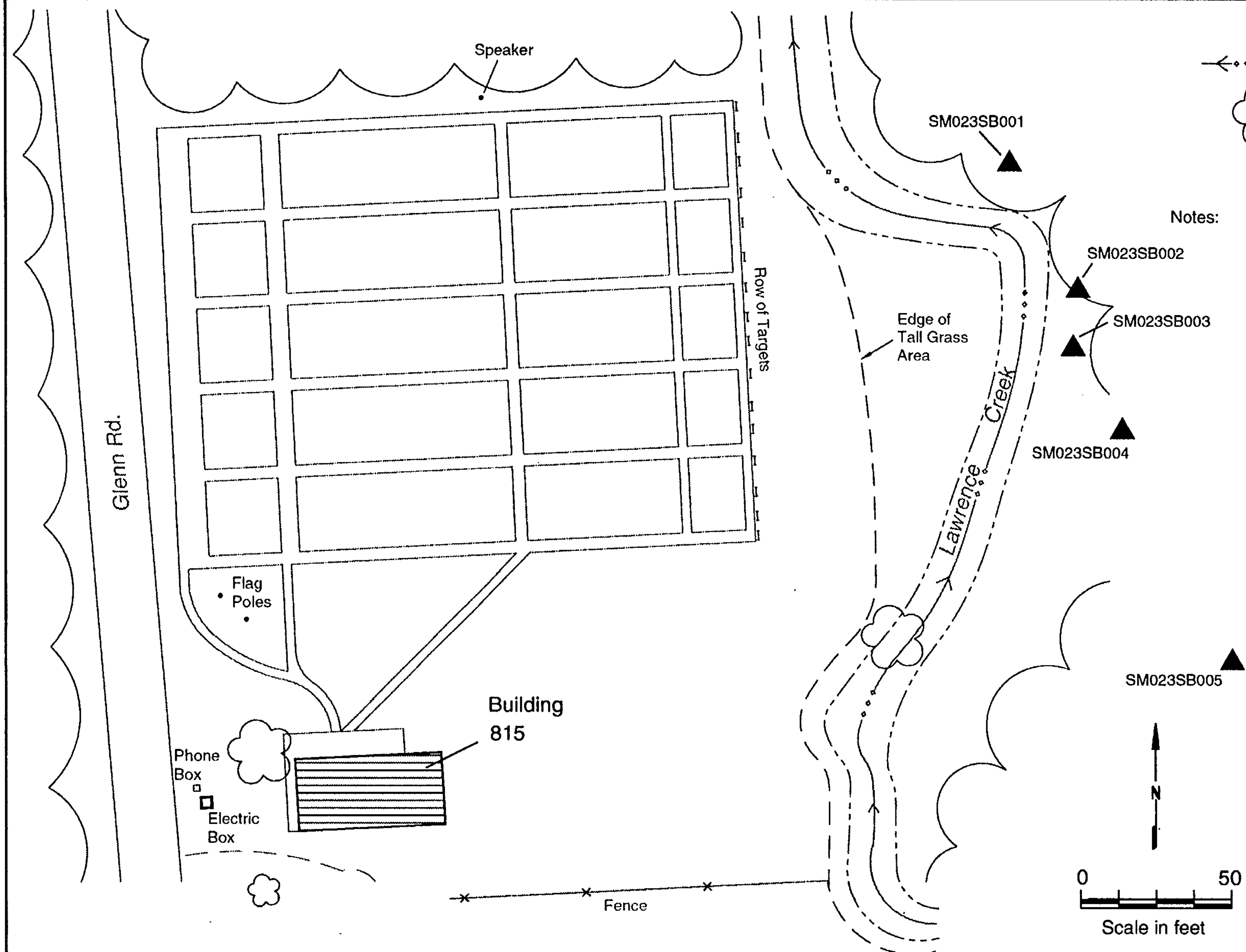
Marion County, Indiana

Figure 4.37

Surface Soil Sampling Results at State Police Pistol Range, Near Building 815 (EI Site SM23)

FBH/FBH007SB 9/11/95 LDZ



Explanation

Surface drainage

Vegetation

Soil boring location

Notes:

1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

SM023SB001			
2.5 ft.	TL	28.7	j

SM023SB002			
2.4 ft.	PB	58.2	j
2.4 ft.	TL	27.4	j

SM023SB003			
2.5 ft.	CU	31.7	j
2.5 ft.	MN	528	
2.5 ft.	NI	34	j
2.5 ft.	PB	164	j

SM023SB004			
2.5 ft.	PB	93.8	j
2.5 ft.	TL	23.7	j

SM023SB004-DUP			
2.5 ft.	NA	424	D
2.5 ft.	PB	30.1	Dj
2.5 ft.	TL	29	Dj

SM023SB005			
2.5 ft.	NA	449	
2.5 ft.	PB	230	j
2.5 ft.	TL	26.5	j

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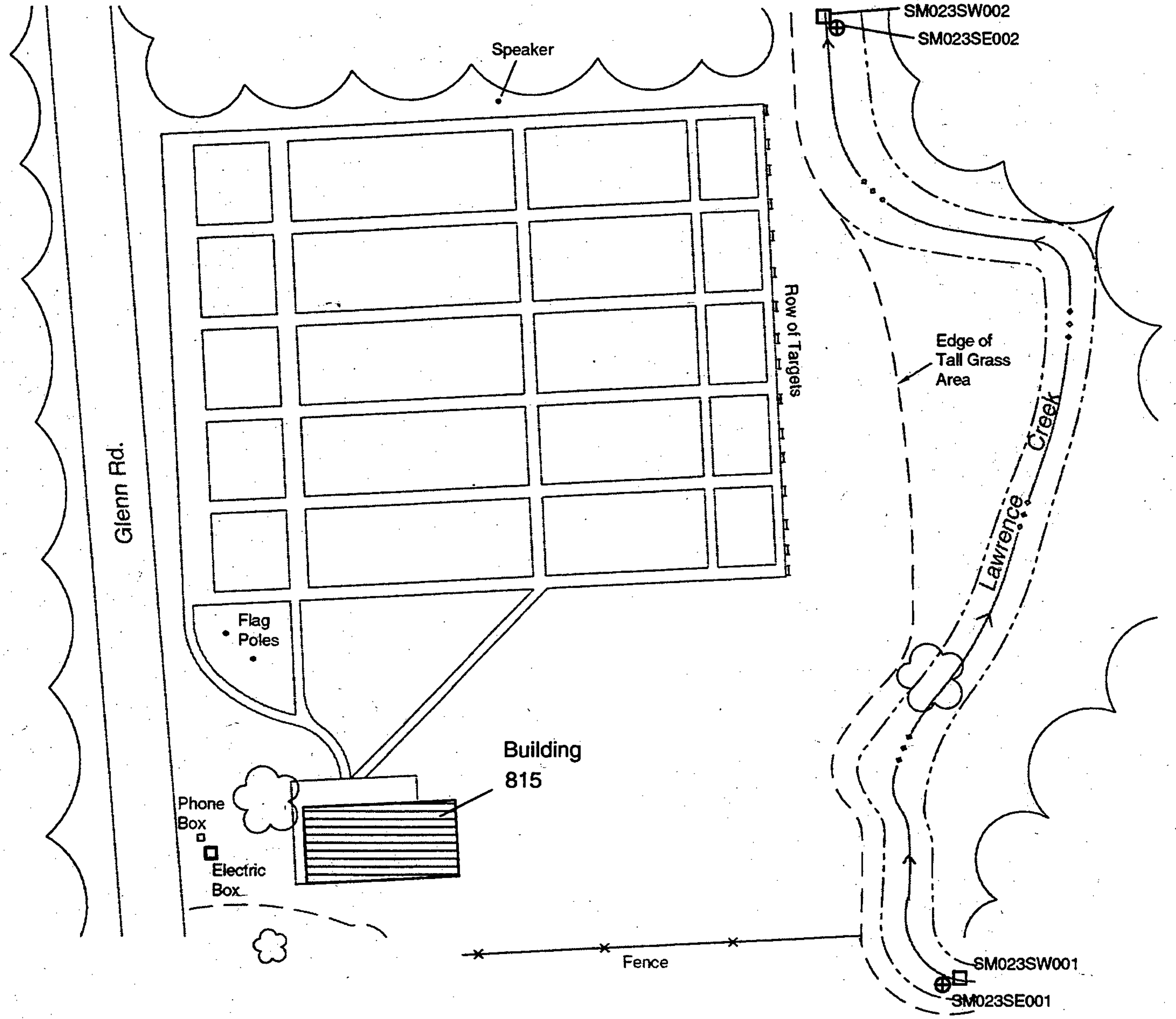
Figure 4.38

Soil Boring Sampling Results at
State Police Pistol Range,
Near Building 815 (EI Site SM23)



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SM023SE001		
AS	4.76	j
CO	3.51	
CR	5.26	
CU	8.4	
FE	6520	
MN	201	
NA	489	
NI	9.27	
PB	6.52	
V	8.4	
ZN	28.8	

SM023SE002		
AS	8.15	j
CO	5.19	
CR	8.77	
CU	14.8	
FE	11600	
MN	284	
NA	506	
NI	14.8	
PB	827	
SB	28.4	j
V	13.6	
ZN	32.1	

SM023SW001		
BA	77.3	F
BA	80.6	
CU	5.7	F
FE	413	j
MN	46.5	
MN	43.1	F
NA	86900	F/l
NA	86200	/l
SB	5.2	Frr

SM023SW002		
BA	89.3	
BA	79.4	F
CU	5.61	F
FE	1550	j
FE	74.4	Fj
MN	72.9	
MN	46.5	F
NA	87700	/l
NA	88200	F/l
PB	3.2	b
PB	4.2	Fb
SB	4.6	Frr

SM023SW002-DUP		
BA	90.1	D
BA	79	DF
FE	1480	Dj
FE	60.7	DFj
MN	75.3	D
MN	46.9	DF
NA	89200	D/l
NA	88500	DF/l
PB	3.9	Db
SB	5.1	DFrr

Explanation

Surface drainage

Vegetation

Surface-water sampling location

Sediment sampling location

Notes: 1. All analyte concentrations for sediment are in milligrams per kilogram (mg/kg). Analyte concentrations for surface water are in micrograms per liter (ug/l).

2. See Table 4.83 for analyte and qualifier definitions.

N

0 50

Scale in feet

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Figure 4.39

Surface-Water and Sediment Sampling Results at State Police Pistol Range, Near Building 815 (EI Site SM23)

FBH/FBH008 9/11/95 LDZ

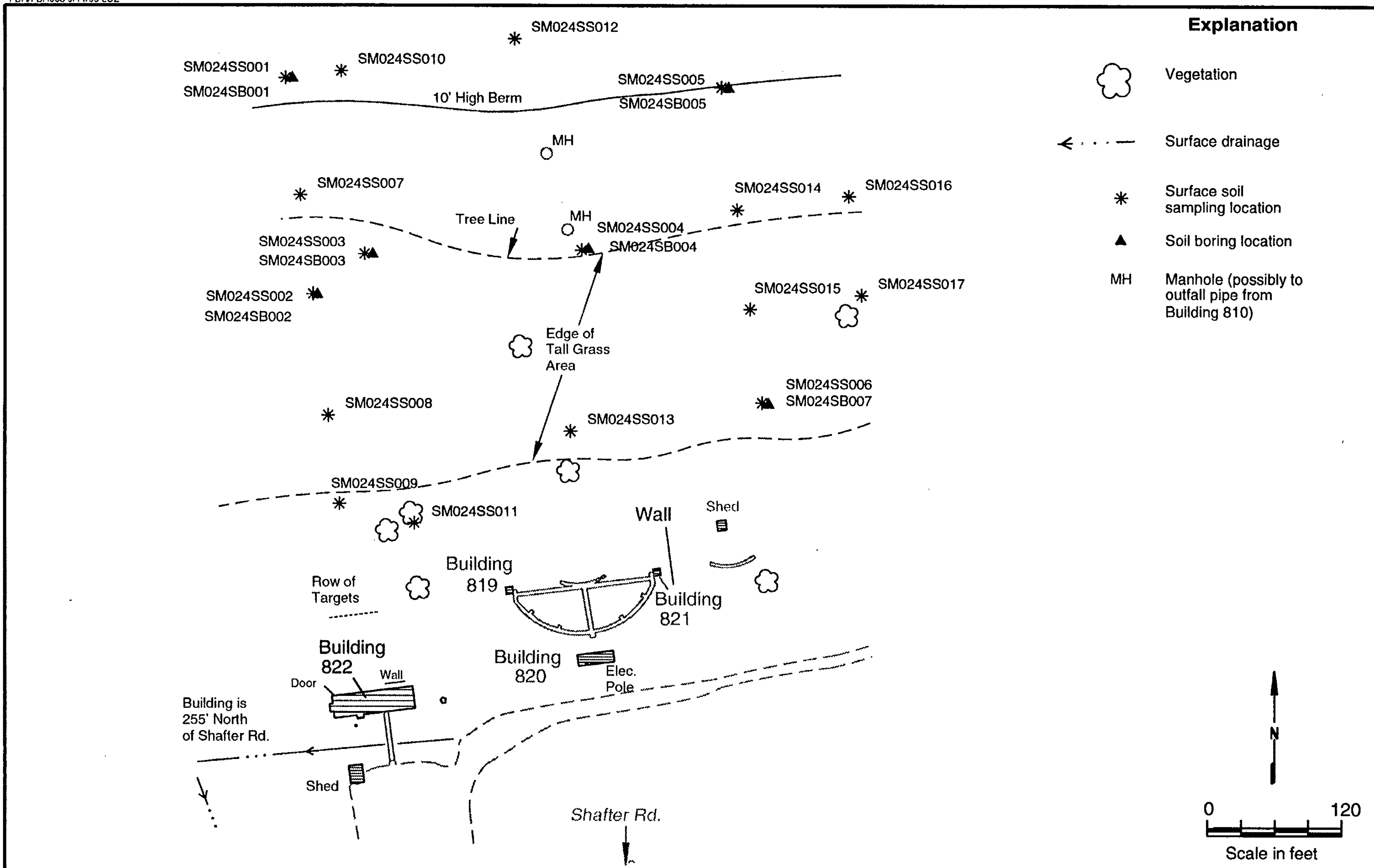

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Figure 4.40

Sampling Locations at Skeet/Rifle Range, Near Buildings 819 Through 822 (EI Site SM24)

SM024SS001		
AS	970	j
CD	.858	
CO	9.22	
CU	24.3	
NA	534	
PB	340	
SE	1.2	rr
ZN	102	

SM024SS001-DUP		
AS	11	Dj
CO	9.92	D
CU	26	D
NA	650	D
NI	21.1	D
PB	423	D
SE	.959	Dj/N
ZN	104	D

SM024SS002		
AS	21	j
NA	430	
PB	859	

SM024SS003		
AS	7.39	j
CU	22.3	
PB	126	
ZN	87.9	

SM024SS004		
AG	3.21	
AS	17	j
CU	26.5	
HG	.363	
NA	488	
PB	56000	
SB	350	j
ZN	82.3	

SM024SS005		
AG	9.52	
AS	1200	j
CU	29	
PB	110000	
SB	14000	j
SE	1.2	rr/N

SM024SS006		
AS	8	j
PB	65.8	
SE	.5	rr/N

SM024SS007		
AG	2.64	
AS	15	j
NA	467	
PB	120000	
SB	3100	j

SM024SS008		
AG	2.71	
AS	84	j
CU	25.7	
PB	57000	
SB	1400	j
SE	.5	rr/N

SM024SS009		
AS	14	j
PB	455	

SM024SS010		
AS	25	j
CU	25	
NA	563	
PB	6880	
SB	78.1	j
ZN	89.1	

SM024SS010-DUP		
AG	1.03	D
AS	91	Drr
CU	64.2	D
NA	610	D
PB	96000	D
SB	4800	Dj

SM024SS011	
PB	119

SM024SS012		
AG	2.78	
AS	140	j
CU	20.5	
NA	439	
PB	100000	
SB	880	j
SE	.41	rr/N

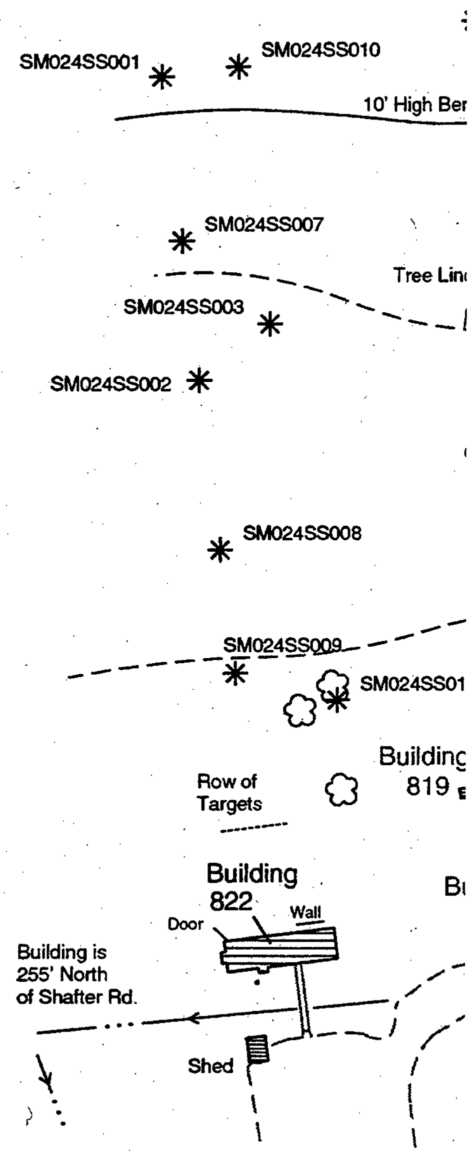
SM024SS013		
AS	8.4	j
PB	83	

SM024SS014		
AS	9.6	j
PB	226	

SM024SS015		
AS	9.7	j
CR	18.9	
FE	20300	
NA	487	
NI	21.7	
PB	135	
V	36.5	

SM024SS016		
AS	1700	j
BA	118	
CR	21.2	
CU	27.3	
FE	22700	
NA	621	
NI	24.2	
PB	1320	
SE	1.2	rr/N
V	40.9	
ZN	121	

SM024SS017		
AS	8.1	j
CO	9.42	
CU	21.1	
NA	568	
PB	308	



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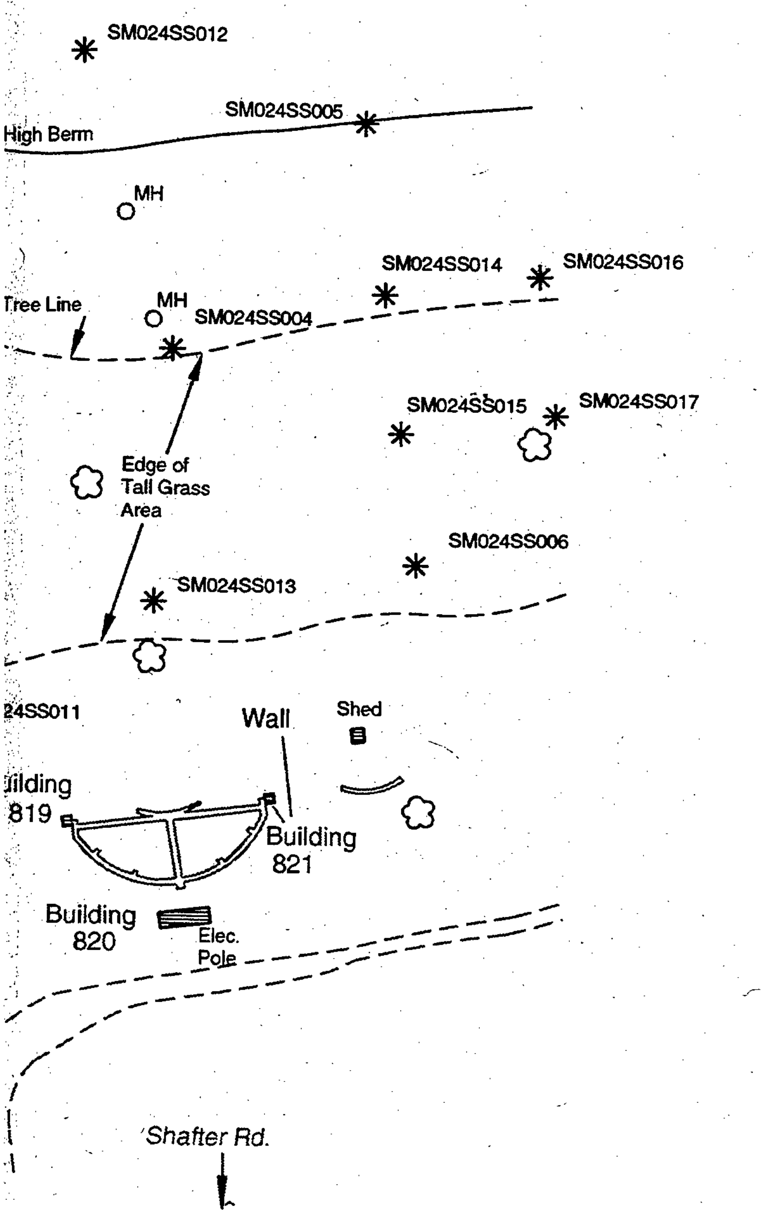

Explanation

Vegetation

Surface drainage

Surface soil sampling location

MH — Manhole (possibly to outfall pipe from Building 810)

Notes:

1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

N

0 120
Scale in feet

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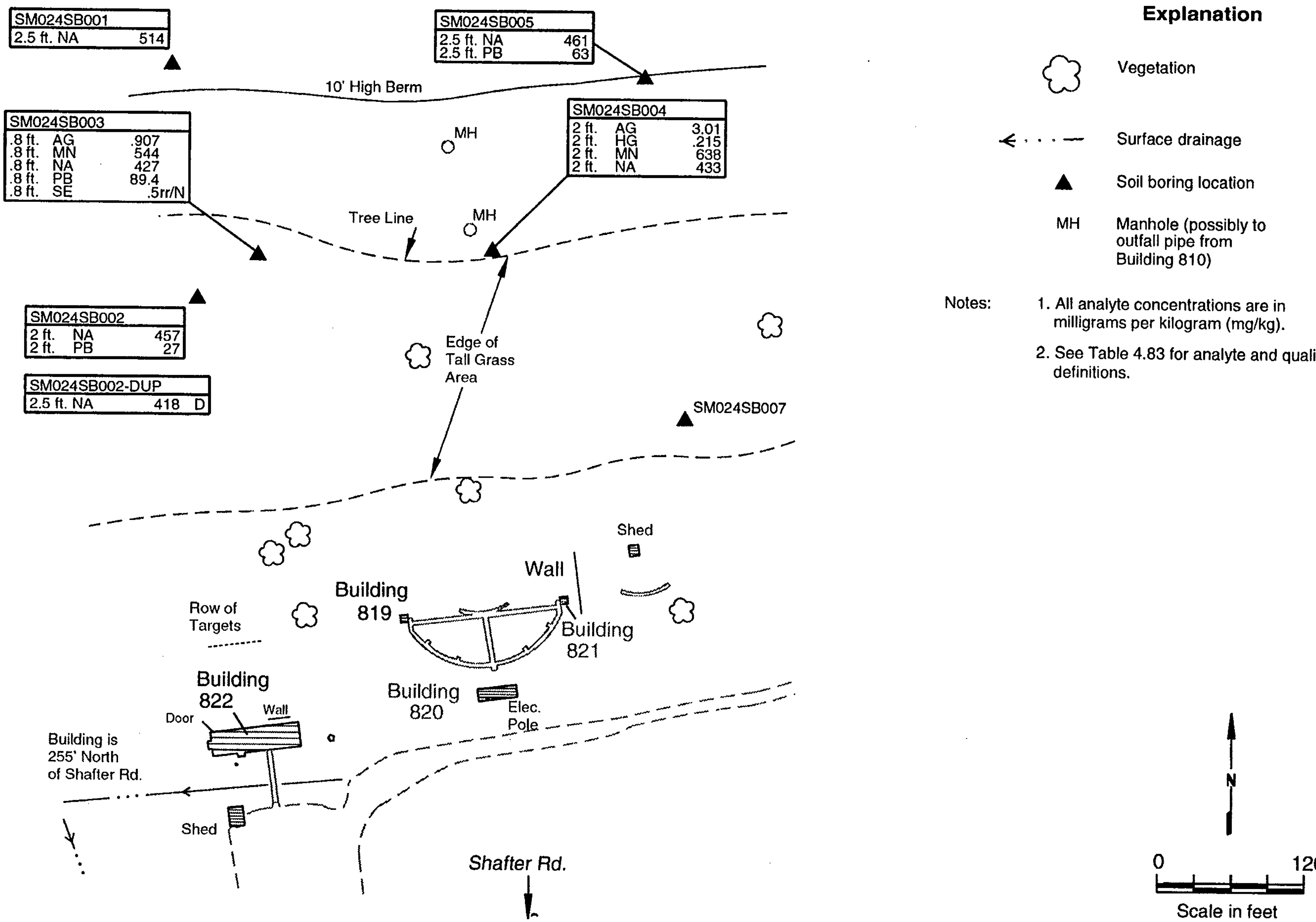
Marion County, Indiana

Figure 4.41

Surface Soil Sampling Results at Skeet/Rifle Range, Near Buildings 819 Through 822 (EI Site SM24)

FBH/FBH008SB 9/11/95 LDZ



Explanation

- Vegetation
- Surface drainage
- Soil boring location
- MH — Manhole (possibly to outfall pipe from Building 810)

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

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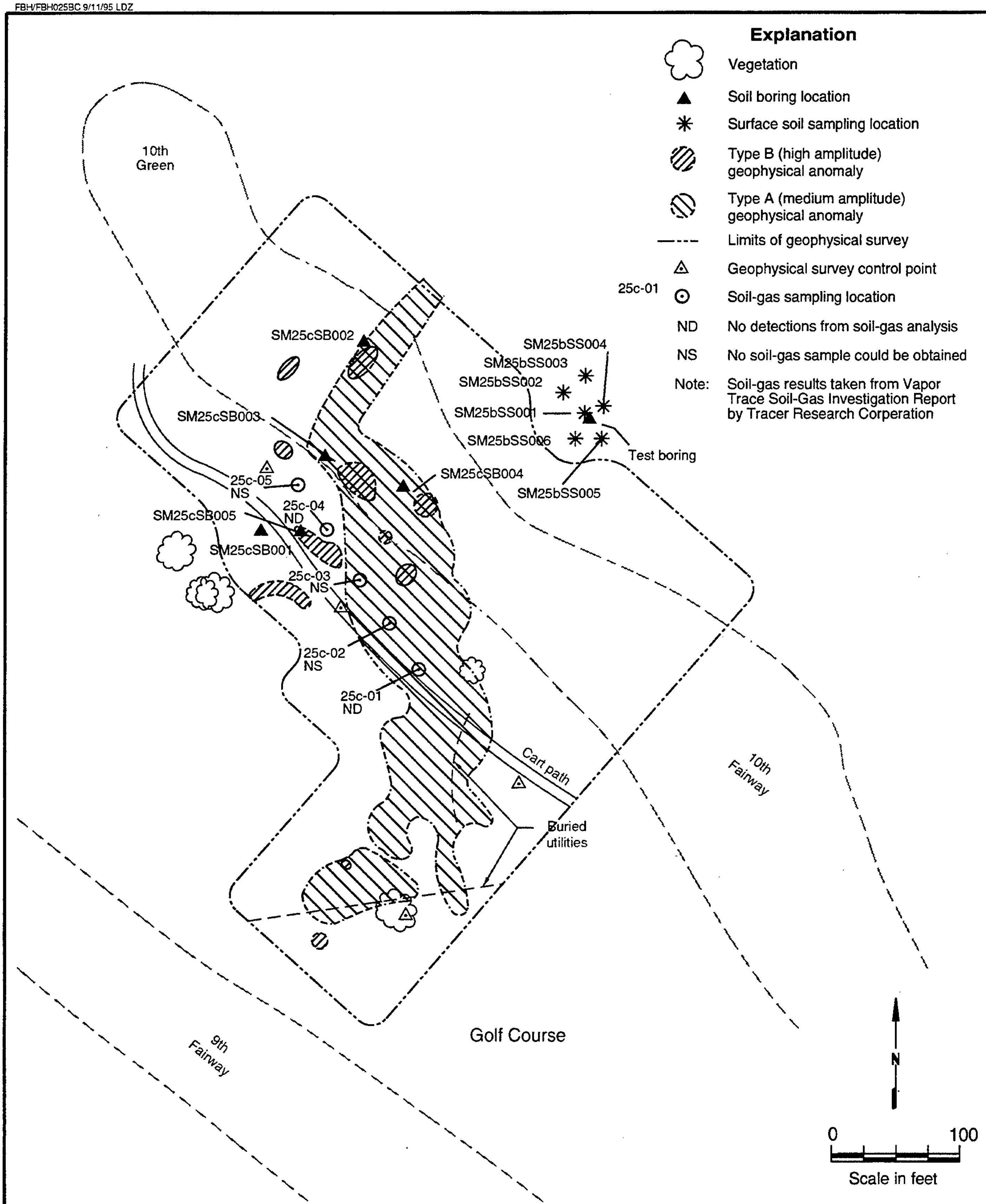
Figure 4.42

Soil Boring Sampling Results at Skeet/Rifle Range, Near Buildings 819 Through 822 (EI Site SM24)

FBH/FBH025BC 9/11/95 LDZ



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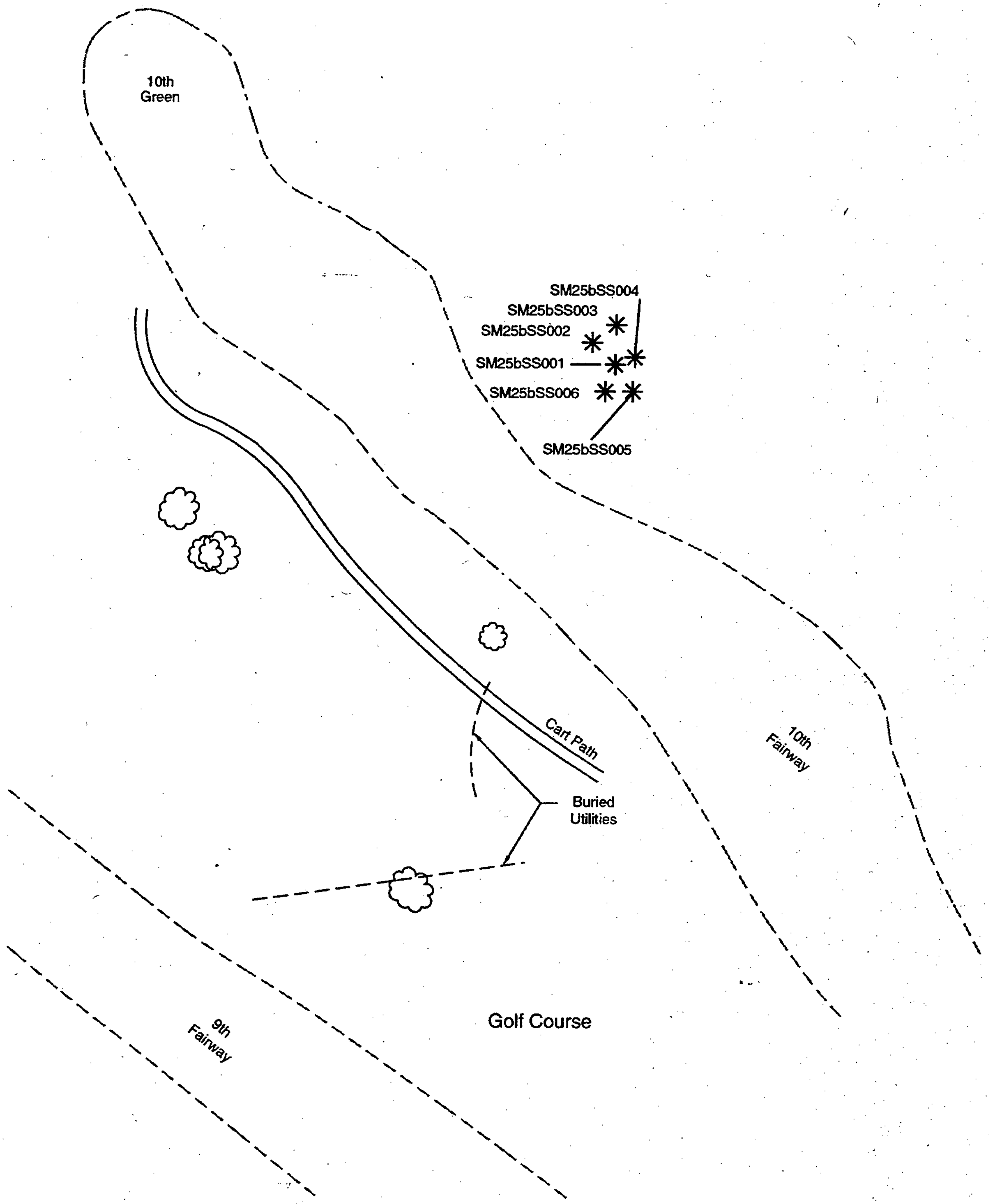
Prepared for: U.S. Army Environmental Center Aberdeen Proving Ground, Maryland Fort Benjamin Harrison Marion County, Indiana	Figure 4.43 Geophysical Survey and Sampling Locations at Historic Military Sites on the Golf Course (EI Sites SM25b & SM25c)



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SM25BSS001		
ANTRC	.23	
B2EHP	1.9	Bb
BAANTR	1.2	
BAPYR	1.3	
BBFANT	1.8	
BEPYR	.85	S
BGHIPY	.93	
BKFANT	.76	
C16A	.36	S
C21	.36	S
C29	.97	S
CHRY	1.4	
DBAHA	.25	
FANT	2.3	
ICDPYR	1	
PHANTR	1	
PYR	1.9	
HG	.355	
PB	121	
ZN	94.2	
NH3	232	
NIT	7.27	j
PH	7.8	rr
TOC	44000	j
TPHENC	2.29	

SM25BSS001-DUP		
ANTRC	.21	D
B2EHP	.41	DBb
BAANTR	1	D
BAPYR	1.2	D
BBFANT	1.5	D
BEPYR	.75	S
BGHIPY	.83	D
BKFANT	.68	D
C16A	.75	S
C20	.63	Sj
C21	1	S
C22	.5	Sj
C23	.38	Sj
C29	.88	S
CHRY	1.3	D
DBAHA	.21	D
FANT	2.1	D
GSITOS	.75	S
ICDPYR	.9	D
PHANTR	.95	D
PYR	1.6	D
CD	.666	D
CU	25.1	D
FE	18800	D
HG	.322	D
PB	126	D
ZN	98	D
NH3	190	Dj
NIT	5.39	D
PH	7.6	Drr
TOC	26000	Dj
TPHENC	1.73	Db

SM25BSS002		
C27	.53	S
C29	.66	S
FANT	.18	JP
CO	8.67	
PB	49.9	
ZN	92	
F	3.84	bj
NH3	238	j
NIT	7.48	j
PH	6.3	rr
TOC	28000	j
TPHENC	1.63	b

SM25BSS003		
B2EHP	3.7	Bb
C29	.41	S
GSITOS	.41	S
BBHC	.0205	C
CO	9.7	
F	3.99	bj
NH3	249	j
NIT	6.37	j
PH	6.7	rr
TOC	25000	j
TPHENC	2.04	b

SM25BSS004		
NI	18.9	
F	3.94	bj
NH3	156	j
NIT	3.92	j
PH	7.8	rr
TOC	18000	j
TPHENC	2.92	b

SM25BSS005		
B2EHP	.38	Bb
C27	.56	S
C29	2.8	S
GSITOS	1.4	S
CO	9.07	
NI	19.5	
NH3	129	j
NIT	7.95	j
PH	7.4	rr
TOC	23000	j
TPHENC	2.71	b

SM25BSS006		
C16A	.46	S
C29	1.5	S
GSITOS	3.1	S
NA	489	
NH3	231	j
NIT	3.19	j
PH	7.6	rr
TOC	38000	j
TPHENC	3.11	b

Explanation

Vegetation

✱ Surface soil sampling location

Notes: 1. All analyte concentrations are in milligrams per kilogram (mg/kg).

2. See Table 4.83 for analyte and qualifier definitions.

N

0 100

Scale in feet

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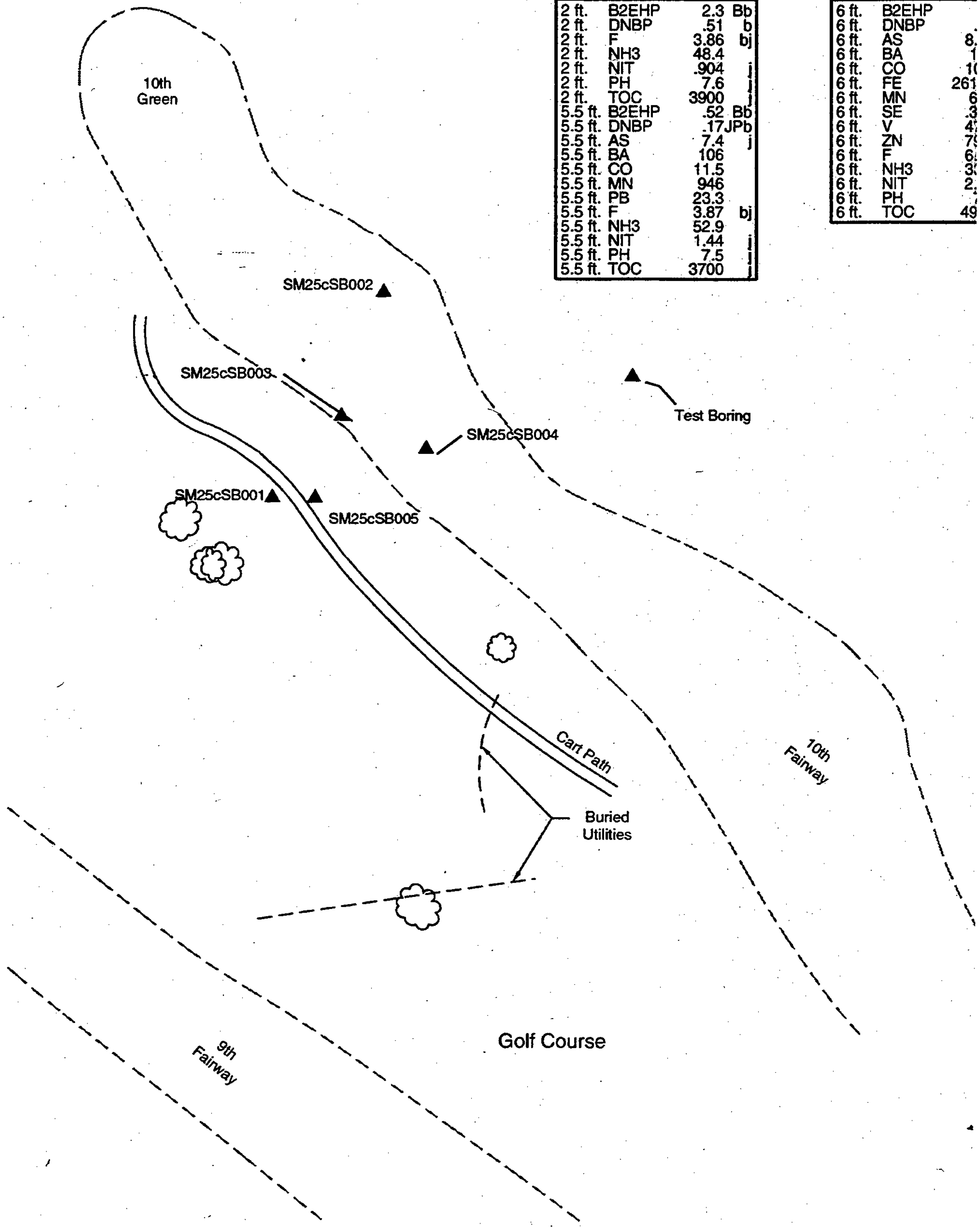
Marion County, Indiana

Figure 4.44

Surface Soil Sampling Results at Historic Military Site on the Golf Course (EI Site SM25b)

SM25CSB001			
2 ft.	B2EHP	2.3	Bb
2 ft.	DNBP	.51	b
2 ft.	F	3.86	bj
2 ft.	NH3	48.4	
2 ft.	NIT	.904	j
2 ft.	PH	7.6	j
2 ft.	TOC	3900	j
5.5 ft.	B2EHP	.52	Bb
5.5 ft.	DNBP	.17	JPb
5.5 ft.	AS	7.4	j
5.5 ft.	BA	106	
5.5 ft.	CO	11.5	
5.5 ft.	MN	946	
5.5 ft.	PB	23.3	
5.5 ft.	F	3.87	bj
5.5 ft.	NH3	52.9	
5.5 ft.	NIT	1.44	j
5.5 ft.	PH	7.5	j
5.5 ft.	TOC	3700	j

SM25CSB001-DUP		
6 ft.	B2EHP	
6 ft.	DNBP	[illegible]
6 ft.	AS	8.
6 ft.	BA	1
6 ft.	CO	1
6 ft.	FE	261
6 ft.	MN	6
6 ft.	SE	.3
6 ft.	V	4
6 ft.	ZN	7
6 ft.	F	6
6 ft.	NH3	3
6 ft.	NIT	2.
6 ft.	PH	[illegible]
6 ft.	TOC	49



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UP	
2	DBb
.19	Db
8.07	Dj
124	D
10.9	D
26100	D
646	D
.335	Drr
47.2	D
79.5	D
6.47	Dbj
33.9	Db
2.05	Dj
7.5	Dj
4900	Dj

SM25CSB002			
1 ft.	ACET	.024	Bb
1 ft.	C16	.67	S
1 ft.	C17	.93	S
1 ft.	C19	.93	S
1 ft.	C20	.4	S
1 ft.	C27	.93	S
1 ft.	C29	.8	S
1 ft.	HG	.274	
1 ft.	NA	466	
1 ft.	PB	546	
1 ft.	ZN	213	
1 ft.	F	3.89	bj
1 ft.	NH3	166	j
1 ft.	NIT	.378	b
1 ft.	PH	7.6	rr
1 ft.	SO4	96.7	
1 ft.	TOC	20000	j
1 ft.	TPHENC	1.45	b
4.5 ft.	ACET	.019	Bb
4.5 ft.	C12	.44	S
4.5 ft.	C13	.44	S
4.5 ft.	C14	.56	S
4.5 ft.	C16	.44	S
4.5 ft.	C17	.56	S
4.5 ft.	C19	.44	S
4.5 ft.	C20	.33	S
4.5 ft.	C21	.33	S
4.5 ft.	CO	7	
4.5 ft.	NIT	.423	bj
4.5 ft.	PH	8.3	rr
4.5 ft.	SO4	102	
4.5 ft.	TOC	23000	j

SM25CSB003			
5.5 ft.	B2EHP	.65	Bb
5.5 ft.	AS	7.93	j
5.5 ft.	BA	80.5	
5.5 ft.	BE	.756	
5.5 ft.	CO	7.8	
5.5 ft.	CU	29.3	
5.5 ft.	FE	26800	
5.5 ft.	NI	34.1	
5.5 ft.	PB	52.4	
5.5 ft.	ZN	159	
5.5 ft.	F	11.5	bj
5.5 ft.	NH3	45.2	j
5.5 ft.	NIT	4.23	j
5.5 ft.	PH	7.8	rr
5.5 ft.	TOC	6000	j
11.5 ft.	B2EHP	.88	Bb
11.5 ft.	DNBP	.67	b
11.5 ft.	B	15.3	
11.5 ft.	CO	4.16	
11.5 ft.	CR	11	
11.5 ft.	CU	15.3	
11.5 ft.	FE	13100	
11.5 ft.	MN	285	
11.5 ft.	NA	515	
11.5 ft.	NI	15.3	
11.5 ft.	TL	18.6	
11.5 ft.	V	18.6	
11.5 ft.	ZN	46	
11.5 ft.	NH3	15.4	bj
11.5 ft.	NIT	.49	b
11.5 ft.	PH	8.4	rr
11.5 ft.	TOC	44000	j

SM25CSB004			
4.5 ft.	B2EHP	.53	Bb
4.5 ft.	FANT	.17	
4.5 ft.	AS	6.9	
4.5 ft.	NH3	14.3	b
4.5 ft.	NIT	4.87	j
4.5 ft.	PH	7.9	j
4.5 ft.	TOC	43000	j
13 ft.	CCL3F	.0086	S
13 ft.	B2EHP	.49	Bb
13 ft.	B	15.1	
13 ft.	CR	6.26	
13 ft.	CYN	1.16	j
13 ft.	NA	475	
13 ft.	PB	5.51	
13 ft.	V	9.83	
13 ft.	CL	6.94	j
13 ft.	NIT	1.06	
13 ft.	PH	8.1	j
13 ft.	SO4	98.7	j
13 ft.	TOC	70000	j

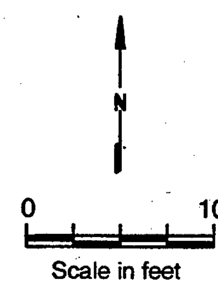
SM25CSB005			
.3 ft.	ACET	.027	
.3 ft.	F	4.26	bj
.3 ft.	NH3	45.4	j
.3 ft.	NIT	2.92	j
.3 ft.	PH	7.5	j
.3 ft.	TOC	7100	j
5.3 ft.	B2EHP	1.9	Bb
5.3 ft.	AS	12	
5.3 ft.	BA	94.2	
5.3 ft.	CO	9.91	
5.3 ft.	FE	24800	
5.3 ft.	MN	570	
5.3 ft.	PB	19.8	
5.3 ft.	SE	.347	rr
5.3 ft.	ZN	89.2	
5.3 ft.	F	8.76	bj
5.3 ft.	NH3	43.4	j
5.3 ft.	NIT	5.03	j
5.3 ft.	PH	7.8	j
5.3 ft.	TOC	3800	j

Explanation

Vegetation

▲ Soil boring location

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.



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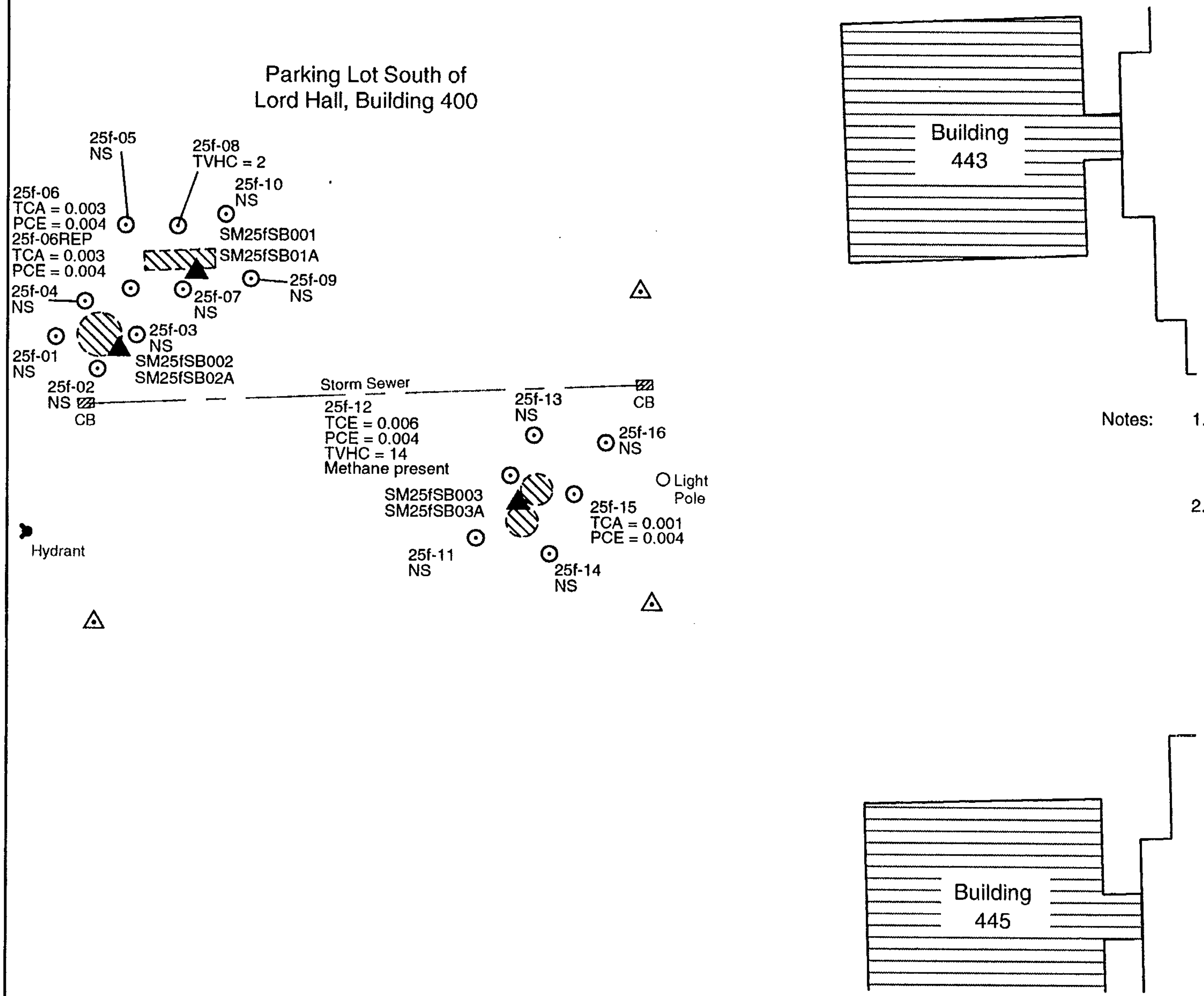
Marion County, Indiana

Figure 4.45

Soil Boring Sampling Results at Historic Military Sites on the Golf Course (EI Site SM25c)

FBH/FBH025F 9/11/95 LDZ



Explanation

- ▲ Soil boring location
- Type B (high amplitude) geophysical anomaly
- △ Geophysical survey control points
- ⊙ Soil-gas sampling location

REP	Replicate
CB	Catch basin
NS	No soil-gas sample could be collected

Notes:

1. Soil-gas results taken from Vapor Trace Soil-Gas Investigation Report by Tracer Research Corporation. All soil-gas concentrations are in micrograms per liter (ug/l).
2. Borings 01A, 02A, and 03A represent soil borings resampled because the original samples arrived above 4°C at the laboratory.

PCE	Tetrachloroethene
TCA	Trichloroethane
TCE	Trichloroethene
TVHC	Total volatile hydrocarbons

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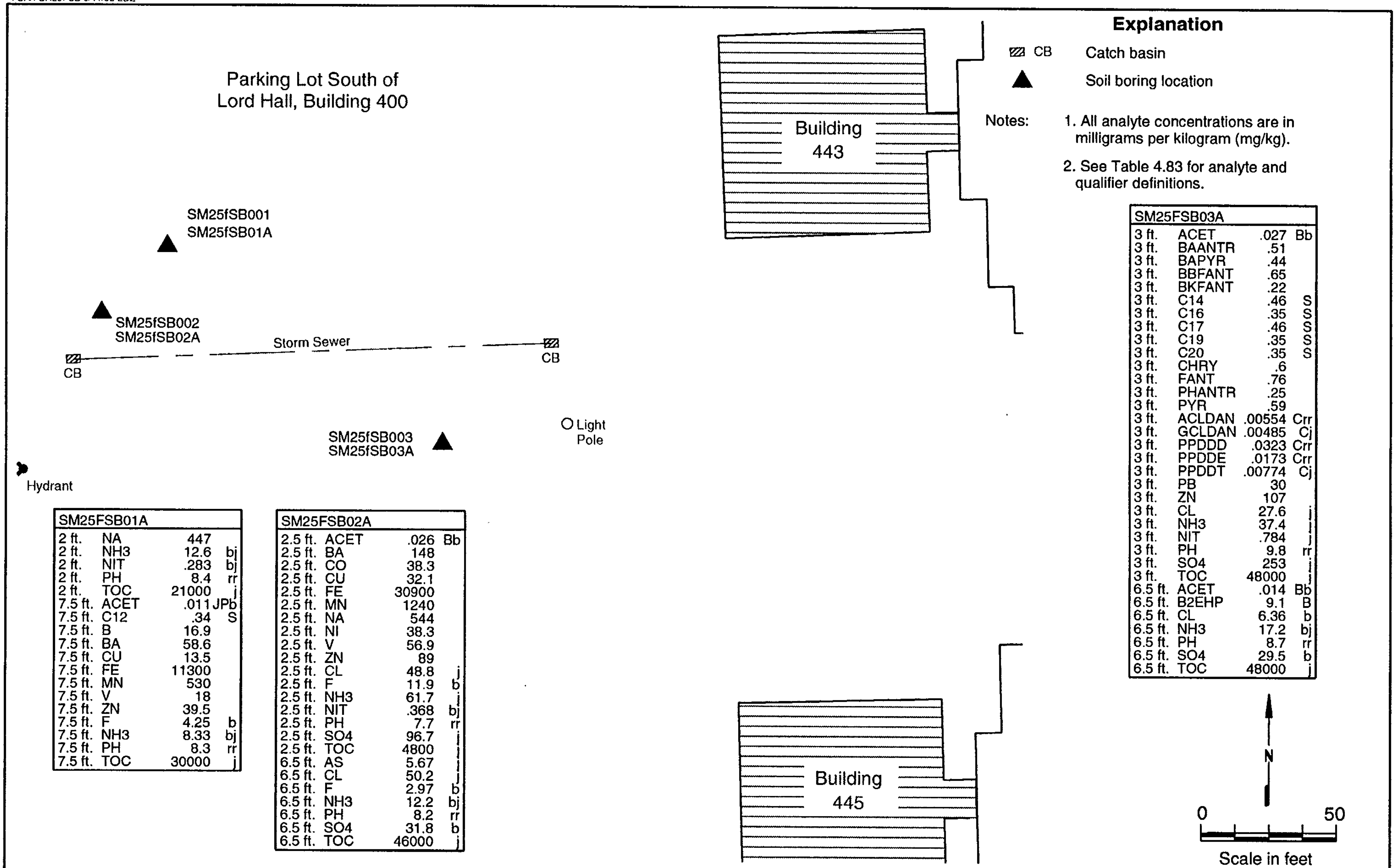
Figure 4.46

Geophysical Survey and Sampling Locations at Historic Military Site, South of Building 400 (EI Site SM25f)

FBH/FBH25FSB 9/11/95 LDZ



Explanation

CB — Catch basin

▲ — Soil boring location

Notes:

1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

SM25FSB01A			
2 ft.	NA	447	
2 ft.	NH3	12.6	bj
2 ft.	NIT	.283	bj
2 ft.	PH	8.4	rr
2 ft.	TOC	21000	j
7.5 ft.	ACET	.011	JPb
7.5 ft.	C12	.34	S
7.5 ft.	B	16.9	
7.5 ft.	BA	58.6	
7.5 ft.	CU	13.5	
7.5 ft.	FE	11300	
7.5 ft.	MN	530	
7.5 ft.	V	18	
7.5 ft.	ZN	39.5	
7.5 ft.	F	4.25	b
7.5 ft.	NH3	8.33	bj
7.5 ft.	PH	8.3	rr
7.5 ft.	TOC	30000	j

SM25FSB02A			
2.5 ft.	ACET	.026	Bb
2.5 ft.	BA	148	
2.5 ft.	CO	38.3	
2.5 ft.	CU	32.1	
2.5 ft.	FE	30900	
2.5 ft.	MN	1240	
2.5 ft.	NA	544	
2.5 ft.	NI	38.3	
2.5 ft.	V	56.9	
2.5 ft.	ZN	89	
2.5 ft.	CL	48.8	j
2.5 ft.	F	11.9	b
2.5 ft.	NH3	61.7	j
2.5 ft.	NIT	.368	bj
2.5 ft.	PH	7.7	rr
2.5 ft.	SO4	96.7	j
2.5 ft.	TOC	4800	j
6.5 ft.	AS	5.67	j
6.5 ft.	CL	50.2	j
6.5 ft.	F	2.97	b
6.5 ft.	NH3	12.2	bj
6.5 ft.	PH	8.2	rr
6.5 ft.	SO4	31.8	b
6.5 ft.	TOC	46000	j

SM25FSB03A			
3 ft.	ACET	.027	Bb
3 ft.	BAANTR	.51	
3 ft.	BAPYR	.44	
3 ft.	BBFANT	.65	
3 ft.	BKFANT	.22	
3 ft.	C14	.46	S
3 ft.	C16	.35	S
3 ft.	C17	.46	S
3 ft.	C19	.35	S
3 ft.	C20	.35	S
3 ft.	CHRY	.6	
3 ft.	FANT	.76	
3 ft.	PHANTR	.25	
3 ft.	PYR	.59	
3 ft.	ACLDAN	.00554	Crr
3 ft.	GCLDAN	.00485	Cj
3 ft.	PPDDD	.0323	Crr
3 ft.	PPDDE	.0173	Crr
3 ft.	PPDDT	.00774	Cj
3 ft.	PB	30	
3 ft.	ZN	107	
3 ft.	CL	27.6	j
3 ft.	NH3	37.4	j
3 ft.	NIT	.784	j
3 ft.	PH	9.8	rr
3 ft.	SO4	253	j
3 ft.	TOC	48000	j
6.5 ft.	ACET	.014	Bb
6.5 ft.	B2EHP	9.1	B
6.5 ft.	CL	6.36	b
6.5 ft.	NH3	17.2	bj
6.5 ft.	PH	8.7	rr
6.5 ft.	SO4	29.5	b
6.5 ft.	TOC	48000	j

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Figure 4.47

Soil Boring Sampling Results at Historic Military Site, South of Building 400 (EI Site SM25f)

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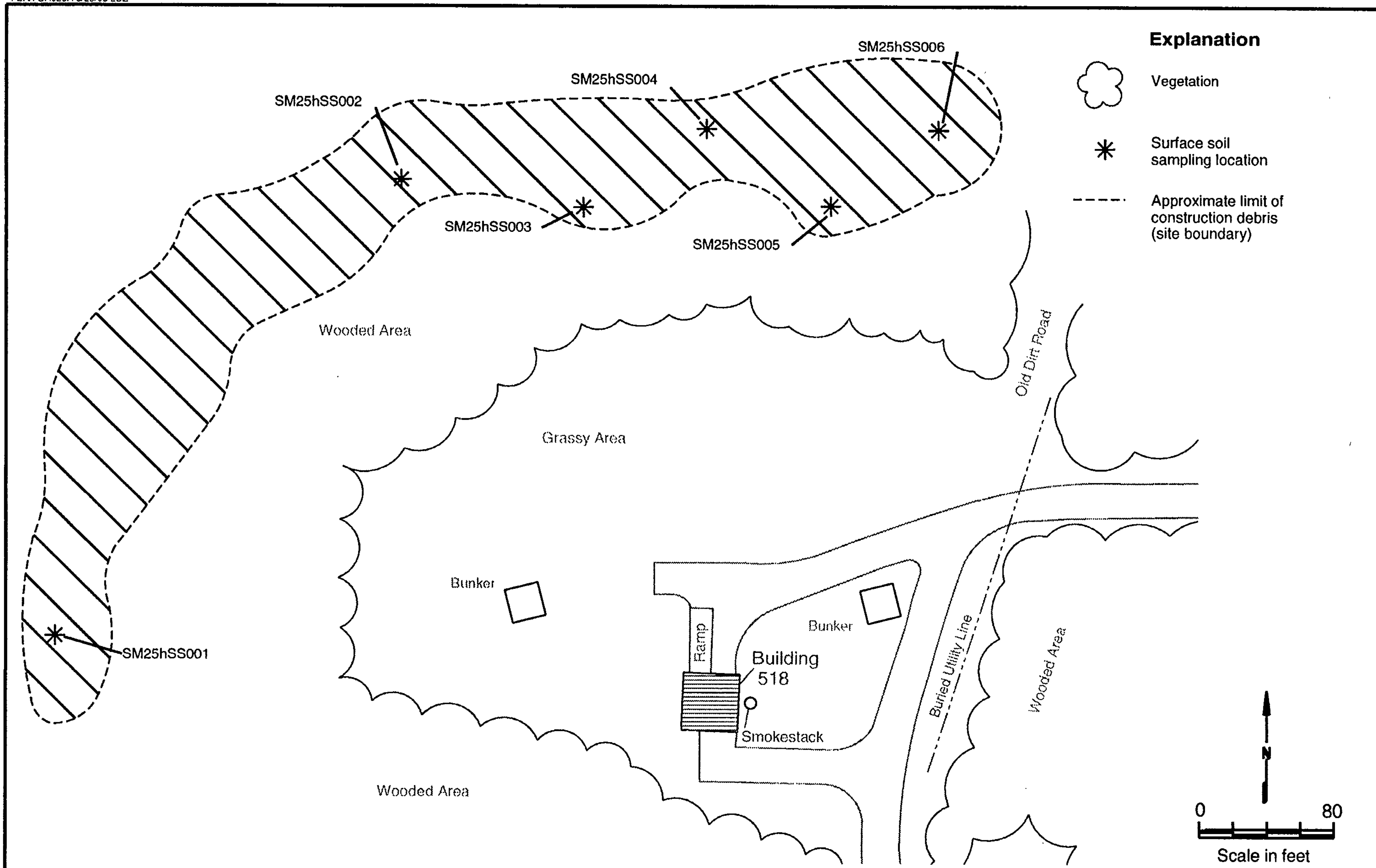

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Figure 4.48

Surface Soil Sampling Locations at
Historic Military Site,
North of Building 518 (EI Site SM25h)

SM25HSS001		
B2EHP	1.8	Bb
C17	.49	S
C29	1.6	S
DNBP	.4	
PPDDT	.00599	Cj
CD	.874	
CO	8.58	
CR	17.8	
CU	25.9	
FE	21000	
NA	566	
NI	24.3	
PB	87.4	
ZN	178	
CL	31.7	
NH3	325	
NIT	2.88	
PH	8	rr
SO4	160	
TOC	37000	j
TPHENC	1.96	b

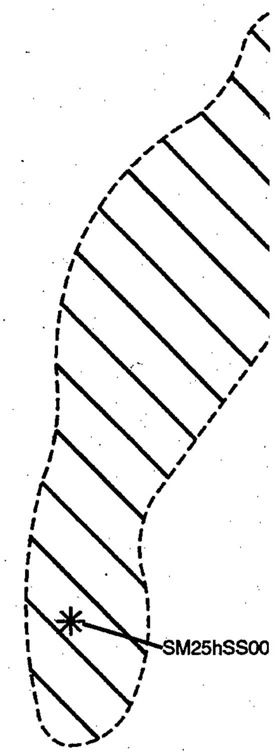
SM25HSS002		
ANAPNE	3	
ANTRC	6	
B2EHP	10	B
BAANTR	10	
BAPYR	10	
BBFANT	20	
BEPYR	8	S
BGHIPY	6	
BKFANT	6	
CARBAZ	3	
CHRY	20	
FANT	30	
FLRENE	3	
ICDPYR	8	
PHANTR	30	
PYR	30	
GCLDAN	.00711	Cbj
PPDDE	.0128	Cj
PPDDT	.102	Cj
CR	18.5	
NA	634	
PB	75.7	
ZN	111	
NH3	326	
NIT	10.3	
PH	8	rr
TOC	51000	j
TPHENC	5.08	

SM25HSS003		
2MNAP	2	
2MPYR	3	S
2PNAP	4	S
ANAPNE	6	
ANTRC	7	
BAANTR	20	
BAPYR	20	
BBFANT	20	
BBFLRE	4	S
BEPYR	10	S
BKFANT	10	
C29	4	S
CARBAZ	5	
CHRY	20	
DBAHA	3	
DBZFUR	5	
FANT	40	
FLRENE	7	
ICDPYR	10	
NAP	3	
PHANTR	40	
PYR	40	
PB	41.2	
NH3	295	
NIT	3.27	
PH	7.8	rr
TOC	20000	j
TPHENC	2.6	

SM25HSS004		
BAANTR	.58	
BAPYR	.58	
BBFANT	.73	
BGHIPY	.33	
BKFANT	.32	
C16A	.67	S
CHRY	.7	
FANT	1.2	
ICDPYR	.38	
PHANTR	.77	
PYR	1	
NA	549	
PB	53.2	
ZN	133	
NH3	316	
NIT	3.33	
PH	7.6	rr
SO4	94.2	
TOC	53000	j
TPHENC	3.59	

SM25HSS005		
BAANTR	.76	
BAPYR	.76	
BBFANT	1.1	
BEPYR	.47	S
BGHIPY	.52	
BKFANT	.41	
CHRY	.96	
FANT	1.6	
GSITOS	1.3	S
ICDPYR	.55	
PHANTR	.85	
PYR	1.4	
PPDDE	.0155	Cj
PPDDT	.0112	Cj
BA	126	
CO	9.32	
CR	22.1	
CU	37.9	
FE	26900	
HG	.314	
NA	585	
NI	26.9	
PB	96.4	
V	36.3	
ZN	237	
CL	9.24	
NH3	199	
NIT	3.97	
PH	7.8	rr
TOC	51000	j

SM25HSS006		
BBFANT	.25	
C16A	.5	S
C27	1.5	S
FANT	.4	
GSITOS	1.7	S
PYR	.35	
HG	.226	
PB	76.9	
ZN	109	
NH3	366	
NIT	3.49	
PH	7.8	rr
TOC	62000	j
TPHENC	6.79	



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Notes: 1. All a
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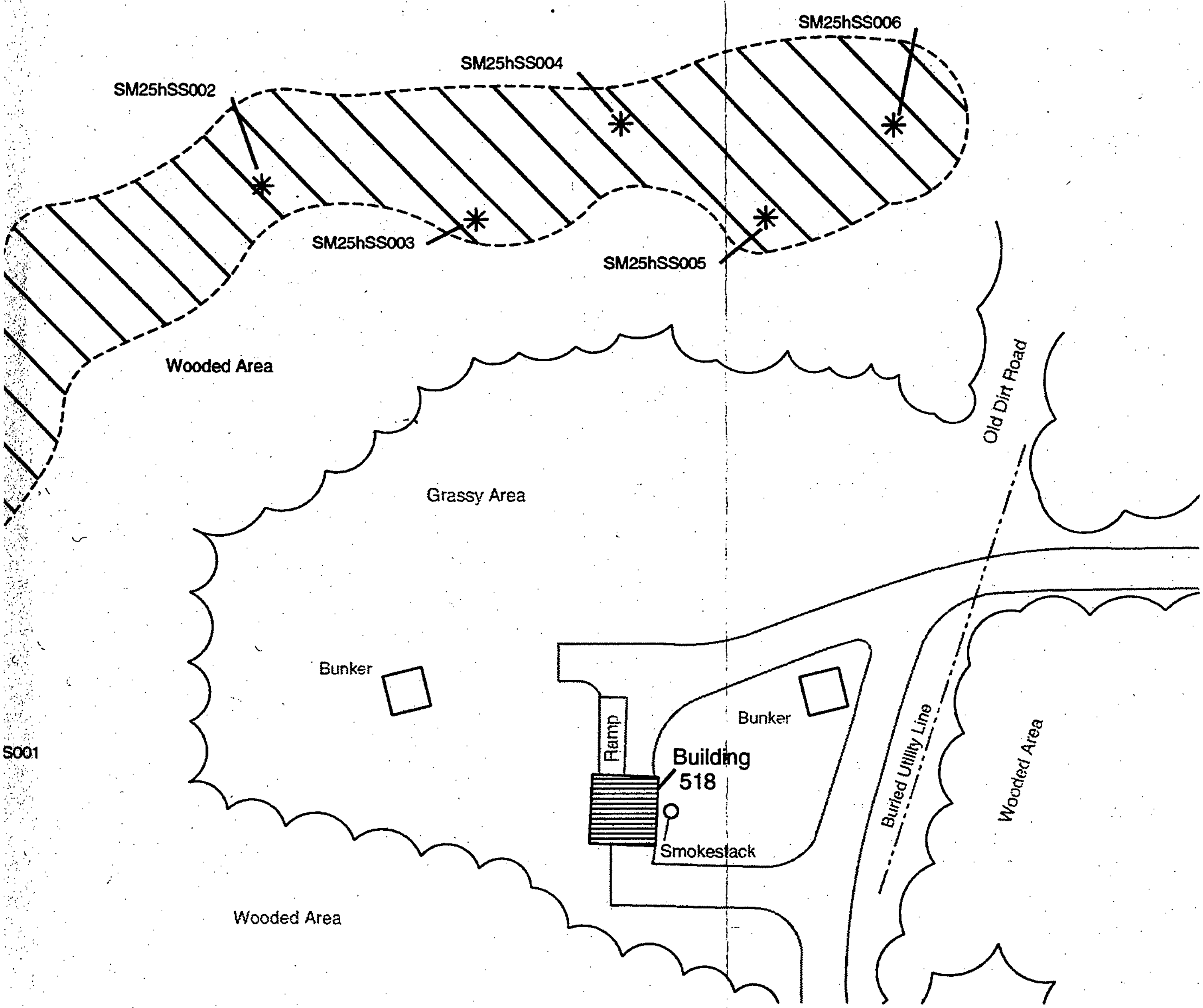


Explanation

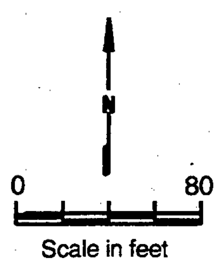
Vegetation

Surface soil sampling location

Approximate limit of construction debris (site boundary)

ıll analyte concentrations are in ıilligrams per kilogram (mg/kg).

ꞩee Table 4.83 for analyte and qualifier efinitions.



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Marion County, Indiana

Figure 4.49

Surface Soil Sampling Results at Historic Military Site, North of Building 518 (EI Site SM25h)

2

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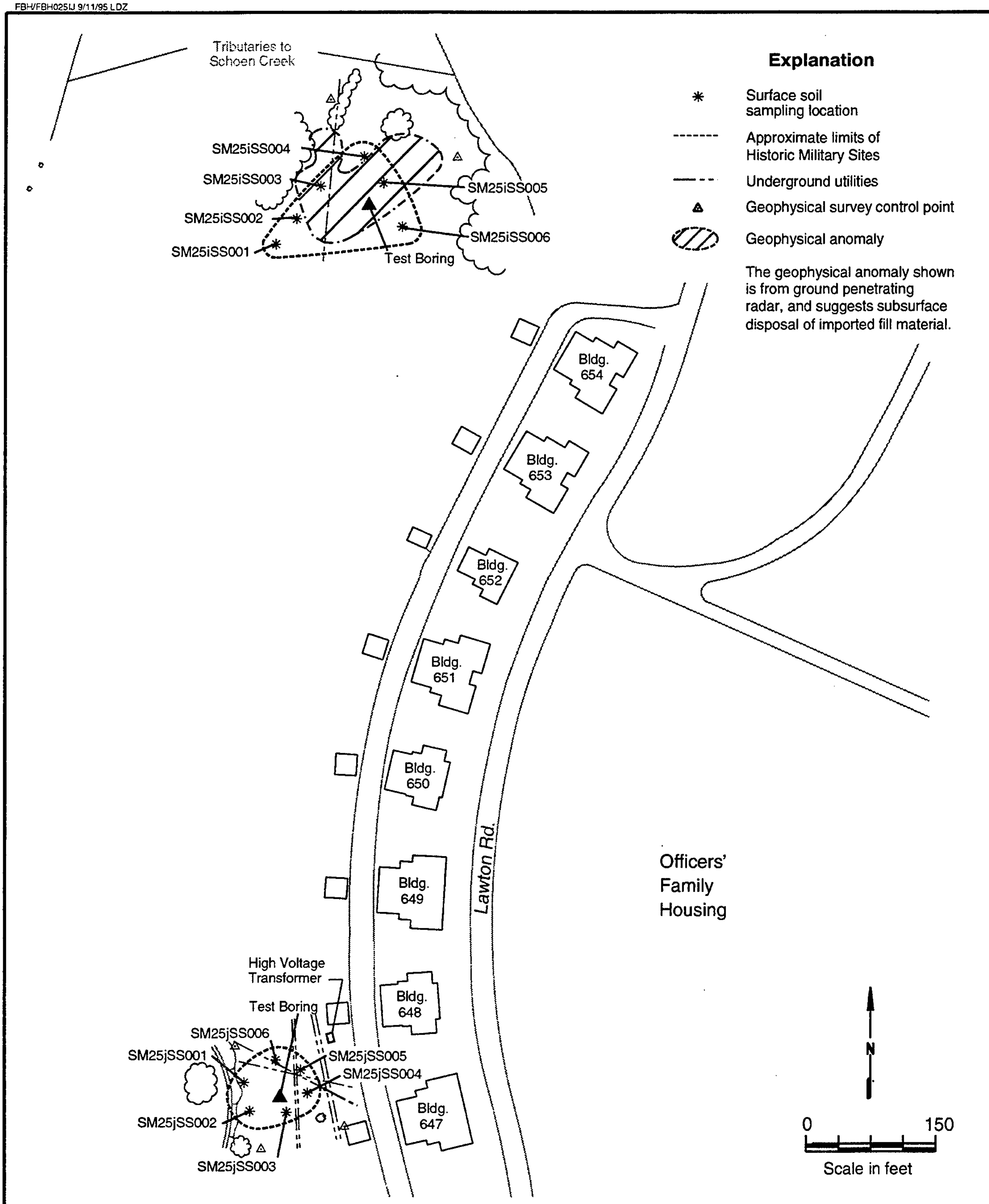

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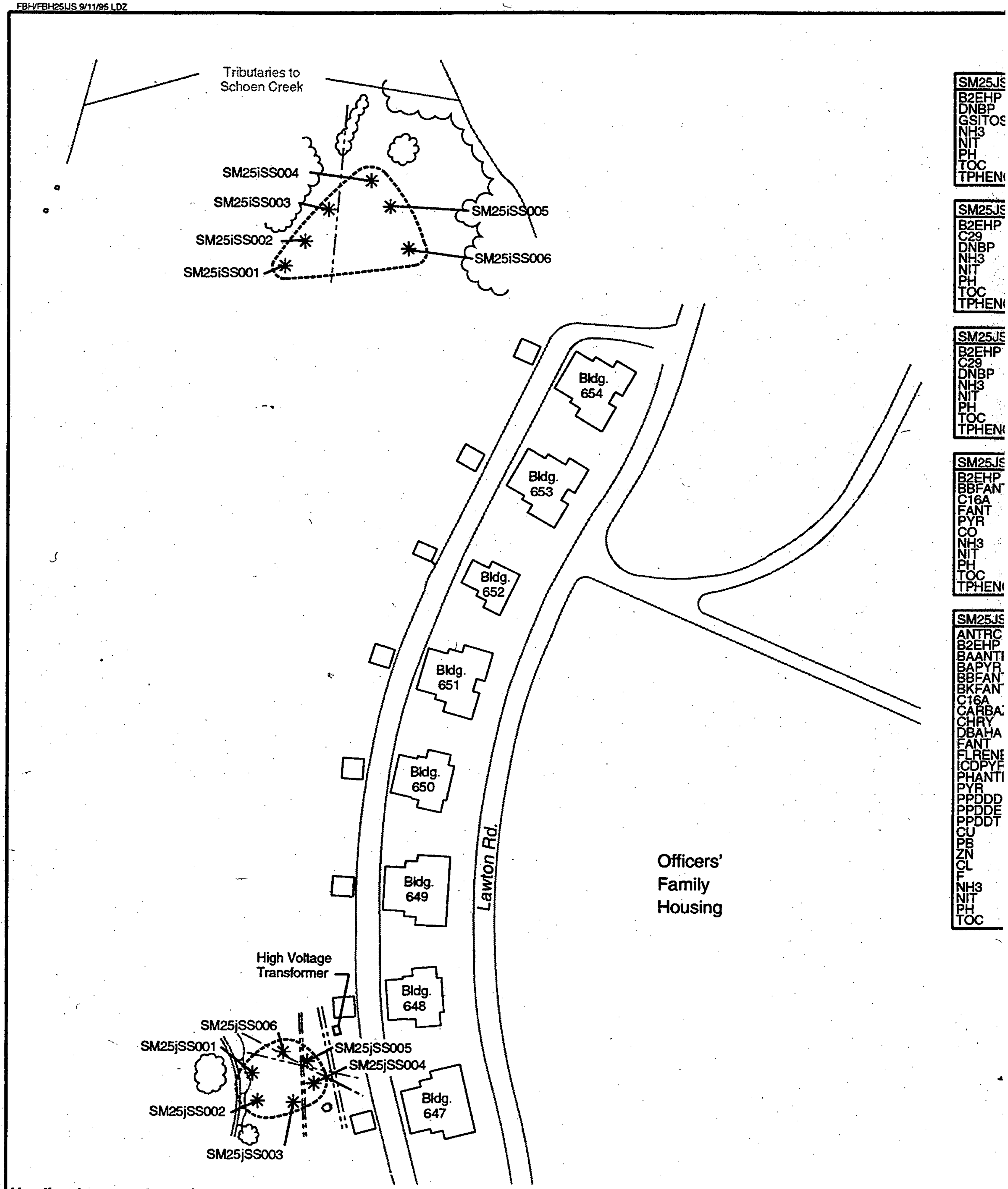

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SS001		
	.29	Bb
	.35	b
	.79	S
	.295	j
	8.55	j
	7.2	rr
	32000	j
C	4.32	

SS001-DUP		
	.81	DBb
	.41	S
	.22	DBb
	272	D
	13.1	D
	7.3	Drr
	30000	Dj
C	1.94	Db

S002		
	.38	Bb
	1.4	S
	.28	b
	288	
	10.9	
	6.9	rr
	31000	j
C	4.46	b

S003		
	.39	Bb
	.2	
	.4	S
	.24	
	.24	
	13.3	
	265	
	12.7	
	6.9	rr
	32000	j
C	8.02	

S004		
	.59	
	.26	Bb
	2.2	
	2.2	
	2.8	
	1.2	
	.81	S
	.24	
	2.7	
	.4	
	4.6	
	.22	
	1.6	
	2.7	
	3.9	
	.13	C
	.27	C
	.27	C
	.54	
	97.2	
	103	
	8.95	j
	4.3	bj
	161	
	6.11	
	7.6	rr
	31000	j

SM25JSS005		
B2EHP	.4	Bb
BAANTR	.25	
BAPYR	.26	
BBFANT	.36	
C27	.37	S
C29	.5	S
CHRY	.35	
FANT	.49	
ICDPYR	.19	JP
PHANTR	.31	
PYR	.45	
PPDDD	.0162	C
PPDDE	.0175	C
PPDDT	.0175	C
CO	9.73	
CR	17.5	
CU	23.7	
FE	21200	
MN	935	
NI	22.4	
ZN	76.1	
NH3	227	
NIT	9.71	
PH	7.7	rr
TOC	40000	j

SM25JSS006		
B2EHP	.49	Bb
BAANTR	.26	
BAPYR	.28	
BBFANT	.38	
BGHIPY	.21	
C29	.5	S
CHRY	.34	
FANT	.55	
ICDPYR	.23	
PHANTR	.28	
PYR	.48	
CU	31.4	
PB	47.7	
ZN	82.9	
NH3	173	
NIT	10.7	
PH	7.7	rr
TOC	29000	j

SM25ISS001		
ANAPYL	.64	
B2EHP	3.2	Bb
BAANTR	.31	
BAPYR	.72	
BBFANT	.72	
BEPYR	.57	S
BGHIPY	1.3	
BKFANT	.29	
C29	.46	S
CHRY	.46	
DNBP	.29	b
FANT	.43	
GSITOS	.92	S
ICDPYR	.69	
PYR	.98	
PPDDD	.0755	Cj
PPDDE	.0755	Cj
PPDDT	.0721	Crr
NH3	86	j
NIT	6.74	j
PH	8	rr
TOC	58000	j
TPHENC	4.27	

SM25ISS002		
B2EHP	.36	Bb
C29	-.99	S
DNBP	.47	b
PPDDD	.0161	Crr
PPDDE	.062	C
PPDDT	.0261	Cj
NA	496	
NH3	234	j
NIT	6.03	j
PH	7.8	rr
TOC	56000	j
TPHENC	2.89	b

SM25ISS003		
B2EHP	.62	Bb
C29	.45	S
DNBP	.27	b
PPDDE	.0437	C
PPDDT	.0168	Cj
ZN	78.5	
NH3	184	j
NIT	3.15	j
PH	8.1	rr
TOC	50000	j
TPHENC	1.14	b

SM25ISS004		
C29	.66	S
PPDDE	.0745	C
PPDDT	.0279	Cj
NH3	205	j
NIT	3.28	j
PH	6.2	rr
TOC	28000	j
TPHENC	1.53	b

SM25ISS005		
B2EHP	.27	Bb
C29	.83	S
DNBP	.5	b
PPDDE	.00814	C
PPDDT	.00698	Cj
CO	9.14	
NH3	320	j
NIT	3.42	j
PH	6.6	rr
TOC	34000	j
TPHENC	1.69	b

SM25ISS006		
C29	1.4	S
DNBP	.2	JPb
PPDDD	.00829	Crr
PPDDE	.00829	C
PPDDT	.00478	Cj
CL	7.12	bj
NH3	201	
NIT	4.47	j
PH	7.4	rr
TOC	32000	j
TPHENC	2.96	b

Explanation

* Surface soil sampling location

-------- Approximate limits of Historic Military Sites

—-- Underground utilities

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte qualifier definitions.

N

0 150

Scale in feet

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Marion County, Indiana

Figure 4.51

Surface Soil Sampling Results at Historic Military Sites, West of Officers' Family Housing Area (EI Sites SM25i & SM25j)

FBH/FBH025k 8/28/95 LDZ

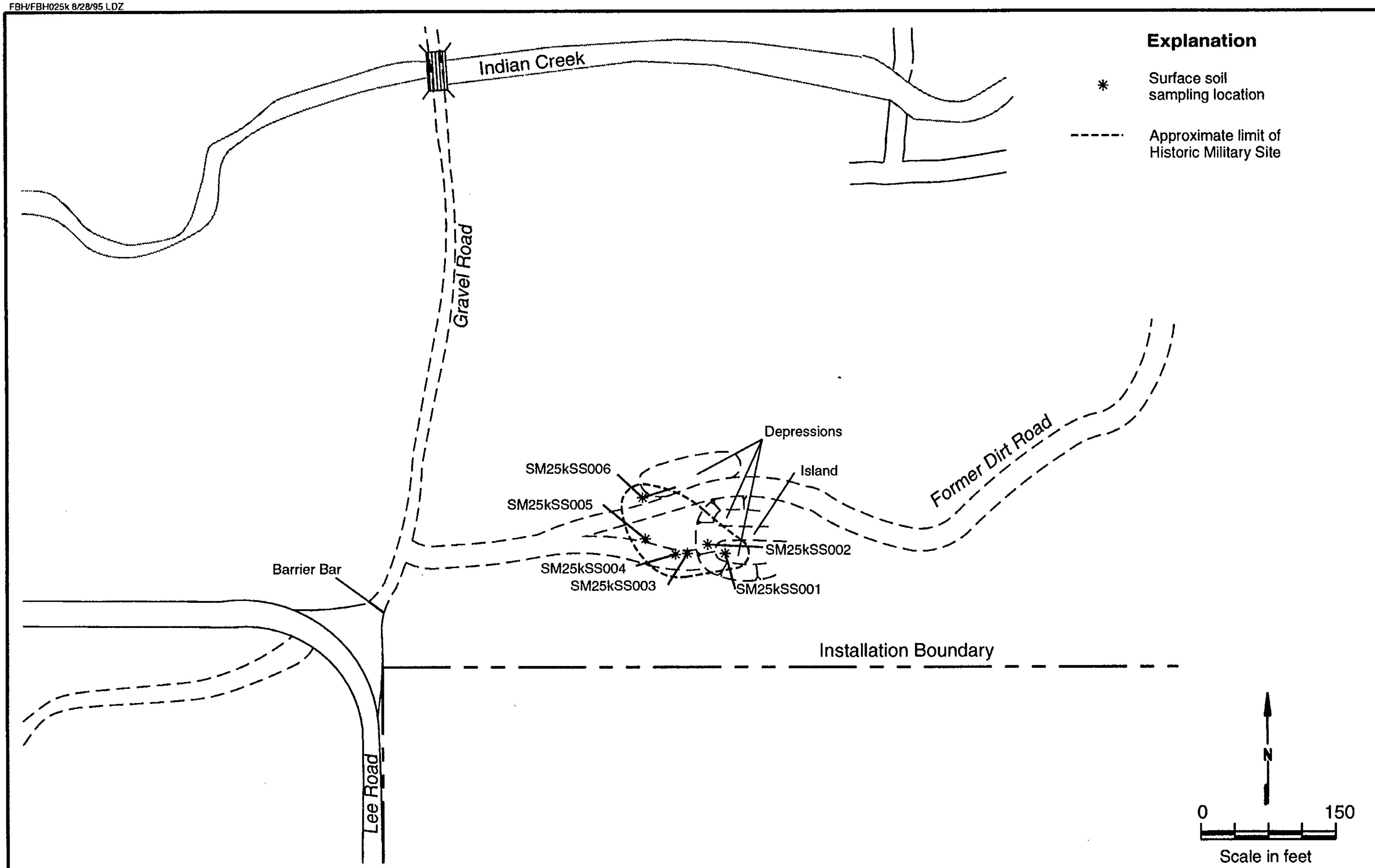

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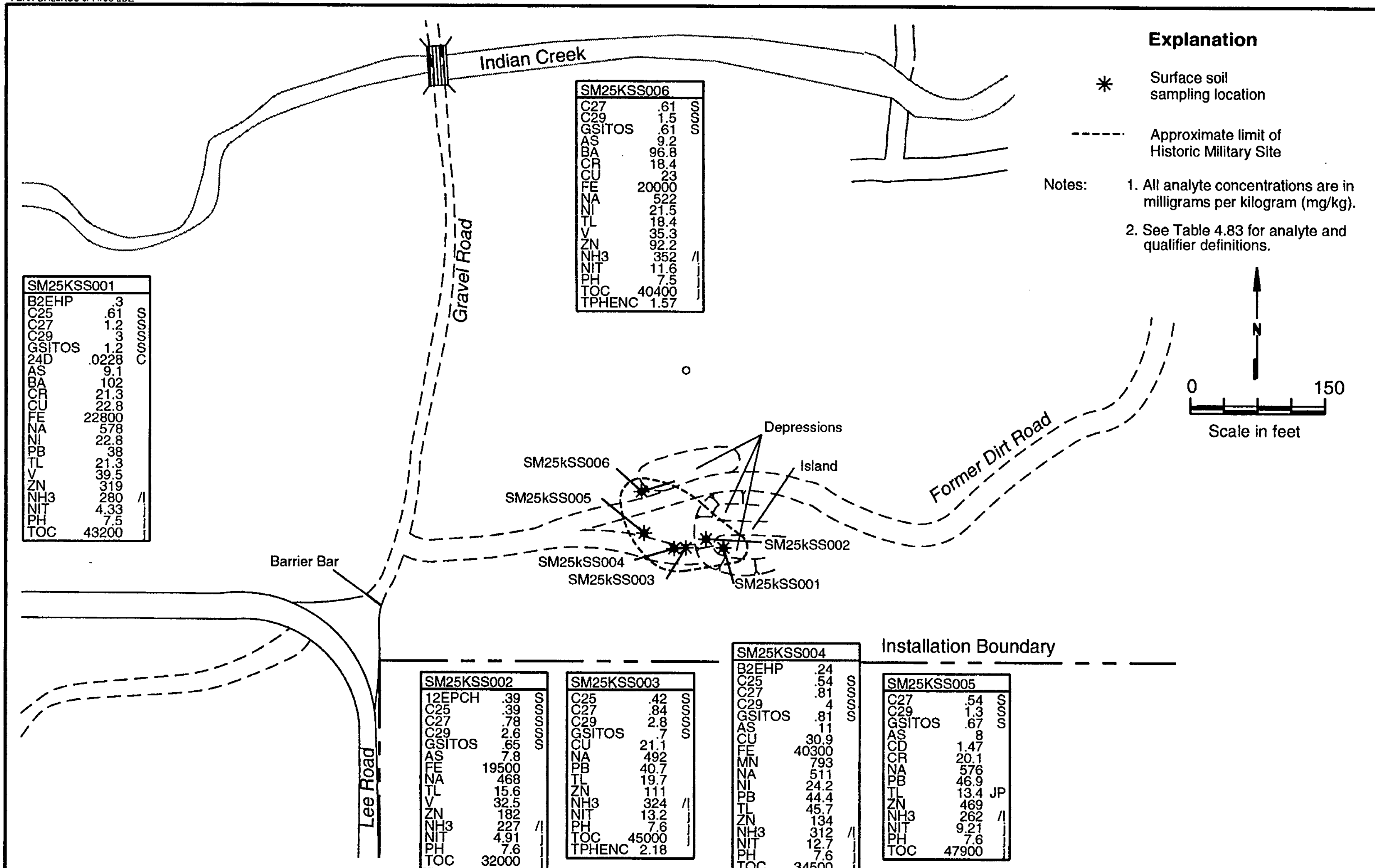
Figure 4.52

Surface Soil Sampling Locations at Historic Military Site, Northeast Boundary of Fort Benjamin Harrison (EI Site SM25k)

FBH/FBH25KSS 9/11/95 LDZ



SM25KSS001		
B2EHP	.3	
C25	.61	S
C27	1.2	S
C29	3	S
GSITOS	1.2	S
24D	.0228	C
AS	9.1	
BA	102	
CR	21.3	
CU	22.8	
FE	22800	
NA	578	
NI	22.8	
PB	38	
TL	21.3	
V	39.5	
ZN	319	
NH3	280	/I
NIT	4.33	J
PH	7.5	J
TOC	43200	J

SM25KSS006		
C27	.61	S
C29	1.5	S
GSITOS	.61	S
AS	9.2	
BA	96.8	
CR	18.4	
CU	23	
FE	20000	
NA	522	
NI	21.5	
TL	18.4	
V	35.3	
ZN	92.2	
NH3	352	/I
NIT	11.6	J
PH	7.5	J
TOC	40400	J
TPHENC	1.57	

SM25KSS002		
12EPCH	.39	S
C25	.39	S
C27	.78	S
C29	2.6	S
GSITOS	.65	S
AS	7.8	
FE	19500	
NA	468	
TL	15.6	
V	32.5	
ZN	182	
NH3	227	/I
NIT	4.91	J
PH	7.6	J
TOC	32000	J

SM25KSS003		
C25	.42	S
C27	.84	S
C29	2.8	S
GSITOS	.7	S
CU	21.1	
NA	492	
PB	40.7	
TL	19.7	
ZN	111	
NH3	324	/I
NIT	13.2	J
PH	7.6	J
TOC	45000	J
TPHENC	2.18	

SM25KSS004		
B2EHP	.24	
C25	.54	S
C27	.81	S
C29	4	S
GSITOS	.81	S
AS	11	
CU	30.9	
FE	40300	
MN	793	
NA	511	
NI	24.2	
PB	44.4	
TL	45.7	
ZN	134	
NH3	312	/I
NIT	12.7	J
PH	7.6	J
TOC	34500	J

SM25KSS005		
C27	.54	S
C29	1.3	S
GSITOS	.67	S
AS	8	
CD	1.47	
CR	20.1	
NA	576	
PB	46.9	
TL	13.4	JP
ZN	469	
NH3	262	/I
NIT	9.21	J
PH	7.6	J
TOC	47900	J

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Aberdeen Proving Ground, Maryland

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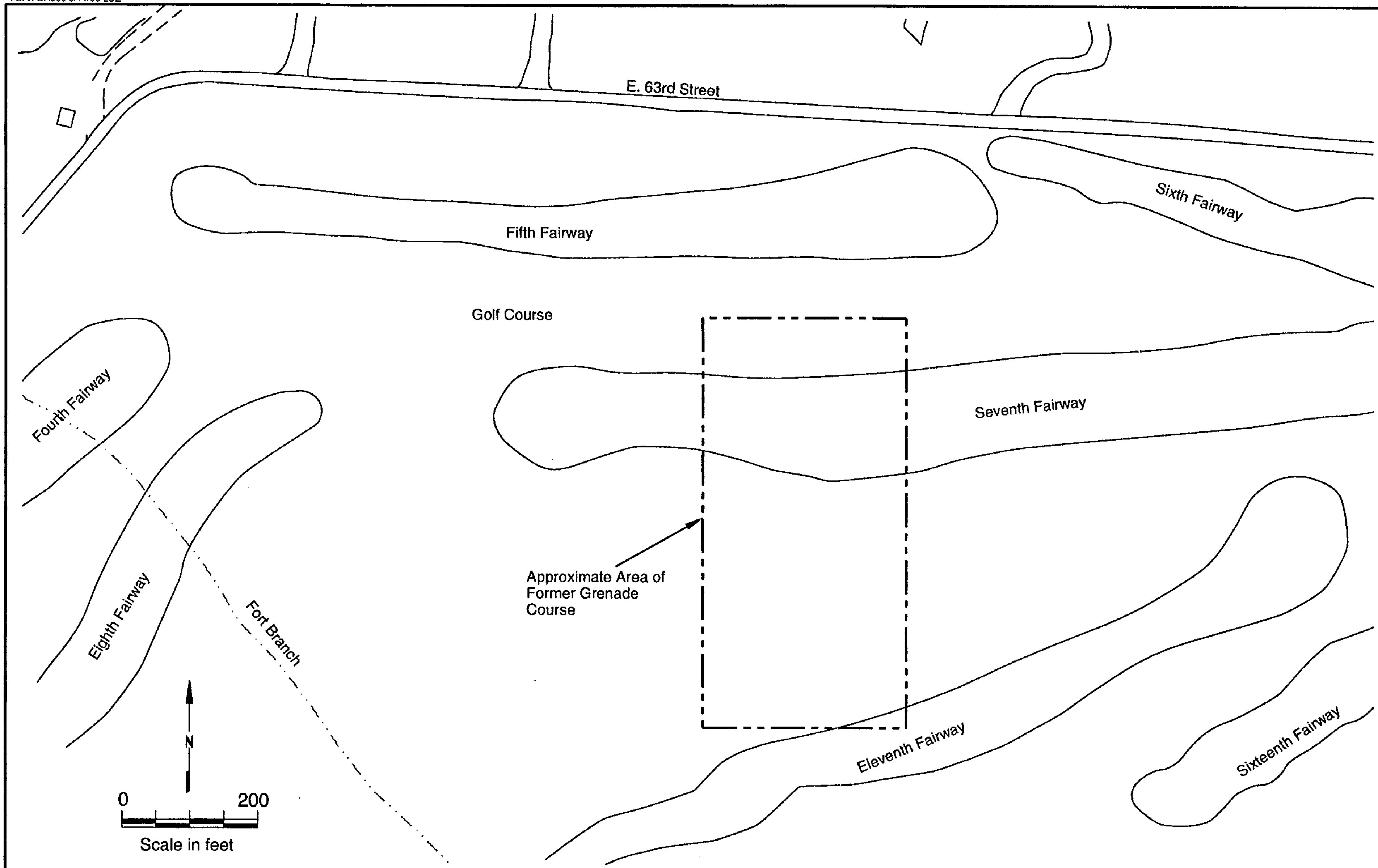
Marion County, Indiana

Figure 4.53

Surface Soil Sampling Results at Historic Military Site, Northeast Boundary of Fort Benjamin Harrison (EI Site SM25k)

FBH/FBH080 9/11/95 LDZ



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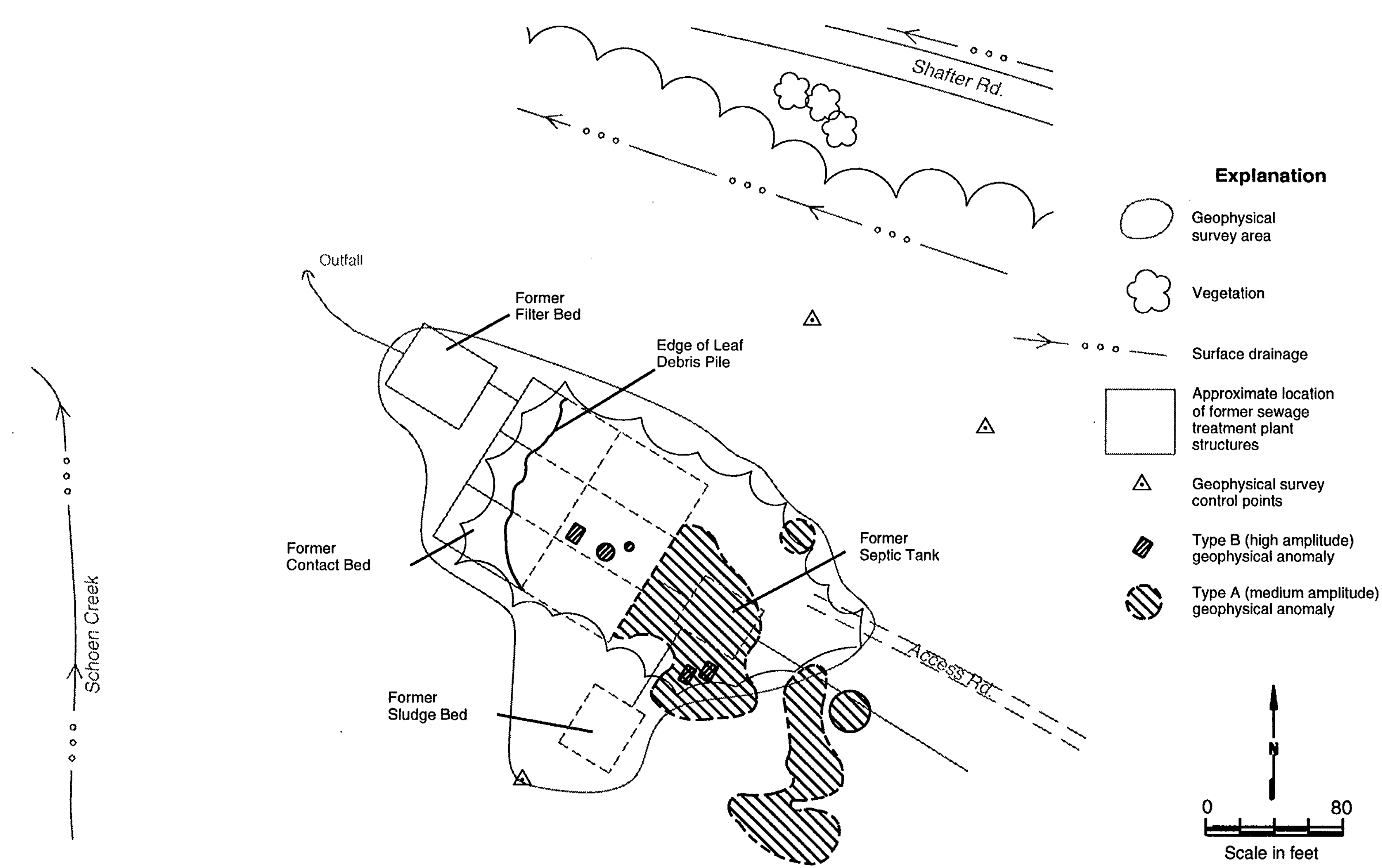
Fort Benjamin Harrison
Marion County, Indiana

Figure 4.54

Location of Historic Military Site, Former Grenade Course, on the Golf Course (EI Site SM25I)

FBH/FBH024 9/11/95 LDZ



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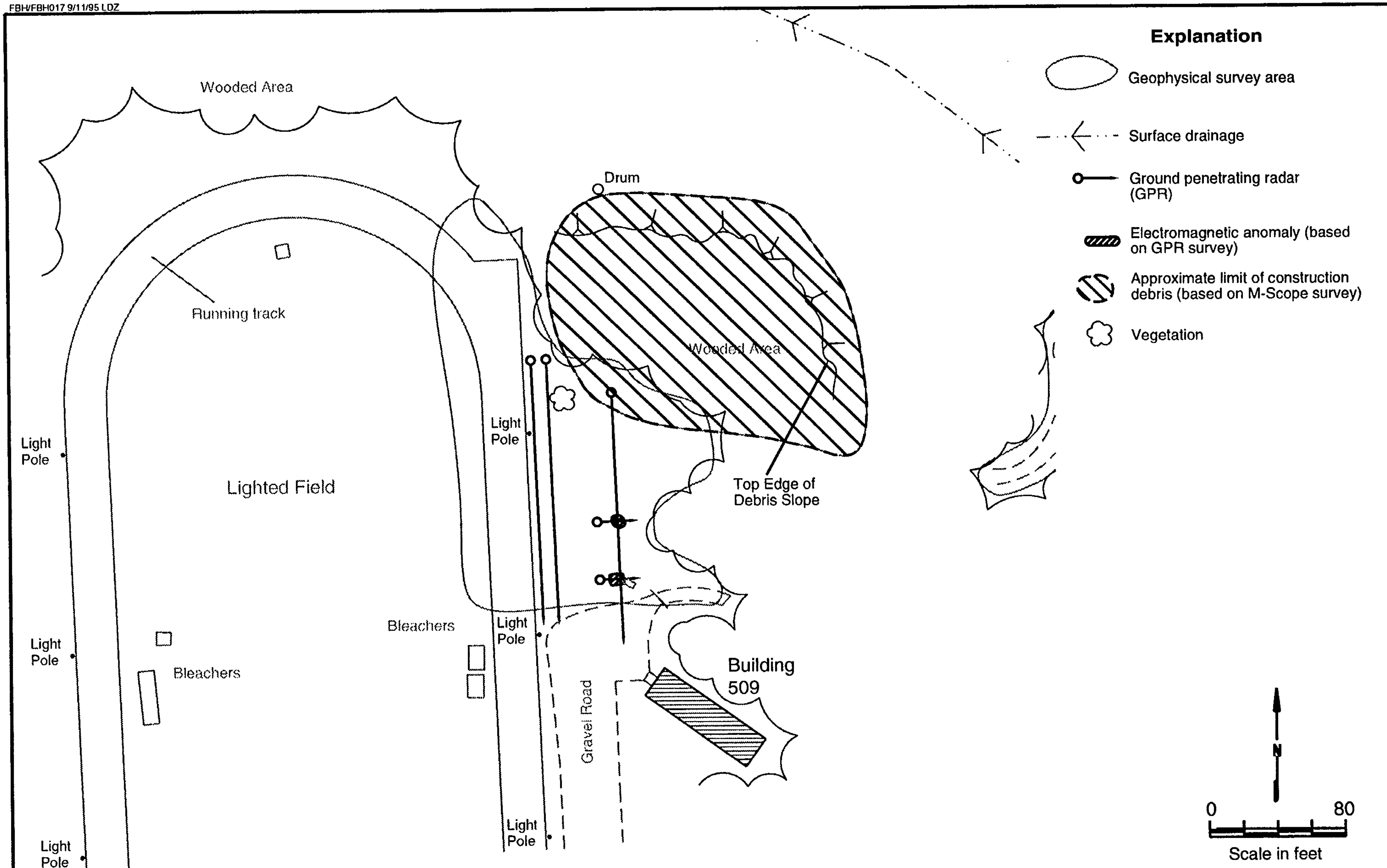
Marion County, Indiana

Figure 4.55
Geophysical Survey Results at
Former Sewage Treatment Plant,
West of Building 674 (EI Site SM26)

FBH/FBH017 9/11/95 LDZ



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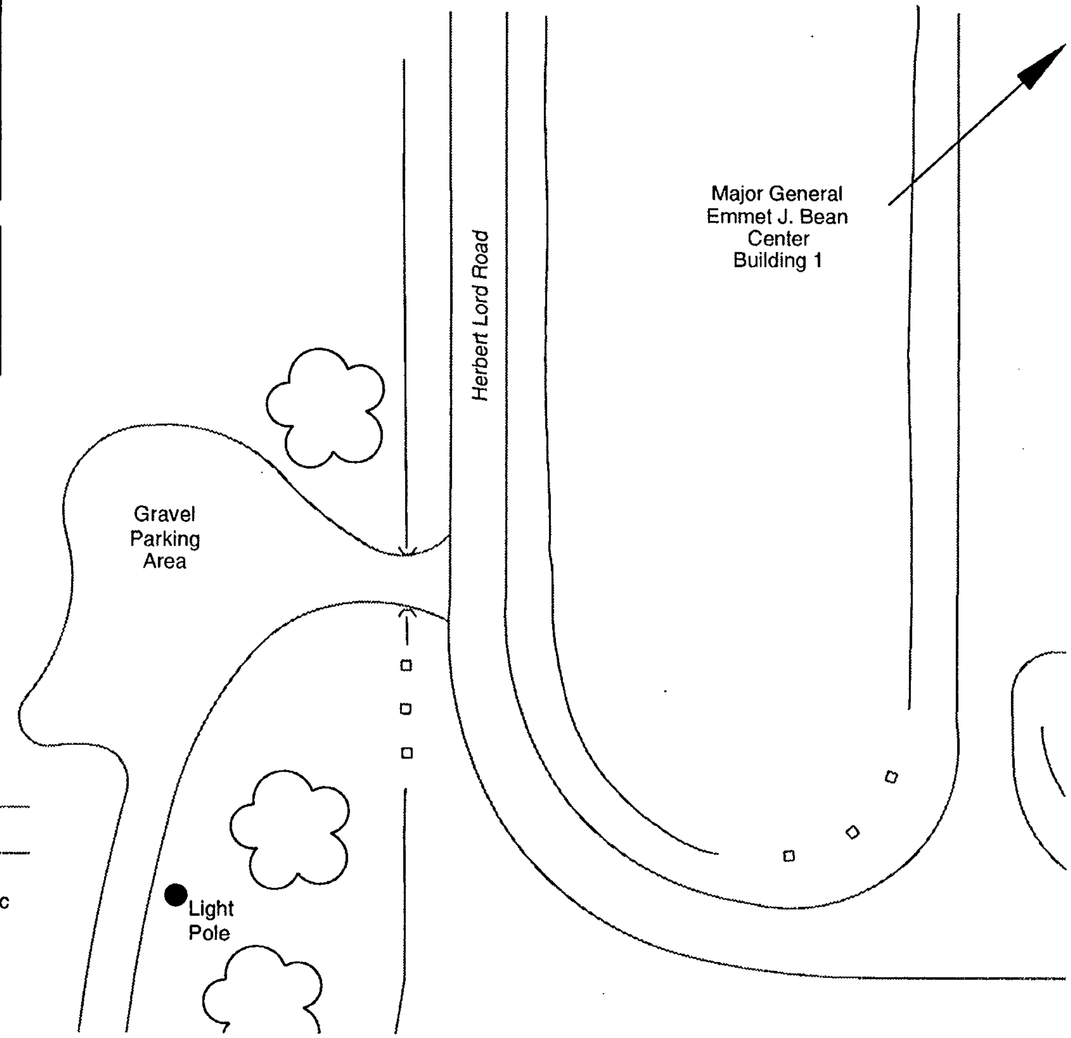
Fort Benjamin Harrison
Marion County, Indiana

Figure 4.56

Geophysical Survey Results at
Former Sewage Treatment Plant,
North of Building 509 (EI Site SM27)

SM029TP001			
2 ft.	2MNAP	.24	
2 ft.	4MP	1	
2 ft.	B2EHP	.49	Bb
2 ft.	C10	.84	S
2 ft.	C11	1.3	S
2 ft.	C13	1.1	S
2 ft.	C14	.84	S
2 ft.	C29	.7	S
2 ft.	ET3MBZ	.42	S

SM029TP002			
2 ft.	4MP	.5	
2 ft.	BENZOA	.32	JP
2 ft.	C16A	1.1	S
2 ft.	C27	.42	S
2 ft.	C29	1.4	S
2 ft.	GSITOS	1.2	S



Explanation

- Vegetation
- Surface drainage
- ✱ Test pit excavation soil sample

Notes:
1. All analyte concentrations are in milligrams per kilogram (mg/kg).
2. See Table 4.83 for analyte and qualifier definitions.

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Marion County, Indiana

Figure 4.57

Patriotic Site Test Pit Location with Subsurface Soil Sampling Results, Southwest of Building 1 (EI Site SM29)

5.0 SUMMARY

This section provides a summary of the conclusions for the Phase I EI and recommendations for the Phase II EI. The Phase I EI conclusions and Phase II recommendations are presented in Table 5.1.

Based on the Phase I EI data, the Army recommends performing Phase II EI activities at each EI site with the exception of the following four Historic Military Sites: EI Site SM25a, EI Site SM25d, EI Site SM25e, and EI Site SM25g. No further action is recommended at these respective sites because there is no indication that hazardous materials or hazardous substances were disposed of by the Army at these sites. Details regarding the Phase II EI activities to be performed at each of the remaining EI sites will be provided in a Phase II Technical Sampling Plan.

In addition to the site-specific recommendations summarized in Table 5.1, two basewide activities are recommended for the Phase II EI:

- Reevaluate FBH background metals and pesticide concentrations to identify representative background concentrations. Additional background sampling should be conducted for the reevaluation.
- Conduct a second basewide groundwater sampling and water-level measurement event of all existing wells to further characterize groundwater quality and flow.

Background metals and pesticide concentrations should be reevaluated because these concentrations in soil at FBH do not appear to have been adequately characterized. At several EI sites where metals concentrations exceed the IDEM background concentrations, the metals appear to be naturally occurring and are unrelated to known activities at the respective sites. In addition, low concentrations of several pesticides, including DDT and its degradation products, in some investigative soil samples are not related to known site activities. Additional background sampling should be conducted and background metals and pesticides concentrations reevaluated during the Phase II EI.

Groundwater quality and flow may vary seasonally and from year to year depending upon precipitation conditions. The Phase I EI included only 1 basewide sampling event. Therefore, an additional basewide groundwater sampling event should be conducted to further characterize groundwater conditions at FBH. Groundwater sampling should be accompanied with a basewide water-level survey to provide additional information regarding water-level fluctuation and groundwater flow at FBH.

Table 5.1: Summary of Phase I Environmental Investigation Conclusions and Recommendations

Site Identification	Conclusions	Recommendations
EI Site 1: Auto Craft Shop, Building 705	• Soil-gas results indicated the detection of 5 VOCs at low concentrations in the 3 soil-gas samples collected at the site. • Subsurface soil metals concentrations exceeded IDEM background concentrations in samples from all 5 borings drilled. Thallium, arsenic, and barium were the most frequently detected metals. The occurrence of metals exceeding background is not related to known site-specific activities. • Subsurface soil detections of organic compounds were reported by the laboratory for acetone; 1,1,2-trichlor-1,2,2-trifluoroethane; and TPH. The occurrence of acetone and 1,1,2-trichlor-1,2,2-trifluoroethane is probably caused by laboratory contamination. • TPH was identified in 1 soil sample at concentrations below IDEM action levels for TPH at UST sites. • One groundwater detection of an organic compound was reported by the laboratory for chloromethane; this occurrence was probably caused by laboratory contamination of the sample.	• Groundwater should be resampled for VOCs to confirm that groundwater quality has not been adversely affected because the source of the solvents found in soil-gas samples was not identified. • A risk assessment should be performed for any identified chemicals of concern following sampling and reassessment of background conditions.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site 3: Former Post Exchange (PX) Gasoline Station, Building 619	• Soil-gas results indicated the detection of 5 VOCs at low concentrations. • Subsurface soil metals concentrations exceeded IDEM background concentrations in samples from 4 of the 5 borings drilled at the site. With the possible exception of lead, the occurrence of metals exceeding IDEM background is not related to known site-specific activities. • Lead was the most frequently detected metal in subsurface soil in concentrations exceeding IDEM background. Although organic lead compounds were historically added to gasoline, lead concentrations were detected below the EPA lead screening levels. • Organic compounds were detected in subsurface soil samples collected from 3 soil borings. Most organic compounds detected are gasoline constituents identified in a sample of fill material collected at a former UST site. • TPH (diesel) concentrations detected at 5.5 feet in Boring EI003SB001 exceeded the IDEM action level for TPH in soil. • Chloroform was detected by the laboratory in 1 groundwater sample. The occurrence of chloroform is unrelated to known site-specific activities.	• Groundwater should be resampled for VOCs to confirm the Phase I analytical results because VOCs identified in soil-gas and subsurface soil samples were not identified in groundwater. • A risk assessment should be performed for any identified chemicals of concern following sampling and reassessment of background conditions. • The Army should consult with IDEM UST personnel to assess whether additional investigation related to USTs is required because the TPH (diesel) concentration in 1 sample in Soil Boring EI003SB001 exceeded the IDEM action level for TPH in soil. (This sample was collected downgradient with respect to topography and groundwater from the former UST site.)

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site 4: Directorate of Installation Support (DIS) Engineering/Maintenance, Building 26	• Ten VOCs (chlorinated and nonchlorinated solvents) were detected in various soil-gas samples from 19 locations. • PCB field screening samples on surface soil tested negative. A low PCB detection (less than the 1 mg/kg EPA residential action level in soil and less than the detection limit of the screening method) was reported in a laboratory confirmation sample. • Low concentrations of pesticides were reported in 1 surface soil sample. • Subsurface soil metals concentrations exceeded IDEM background concentrations in samples from all 5 borings. Seventeen metals and cyanide were detected above IDEM background, with thallium and manganese occurring most frequently. The occurrence of metals exceeding IDEM background is not related to known site-specific activities. • Subsurface soil detections of organics were reported in samples from all 5 borings. TCE and PCE each were detected in samples at concentrations of less than 1 mg/kg, and may be related to site cleaning and maintenance activities. • Groundwater metals concentrations exceeded IDEM background concentrations in all 4 monitoring wells at EI Site 4. The highest concentrations for 10 of 12 metals exceeding background were reported in the upgradient well (EI004MW003). • Groundwater detections of organics were reported for all 4 wells. However, compounds detected were either present in laboratory blanks, were not detected consistently, or were TICs.	• Additional surface and subsurface soil sampling should be performed to evaluate the extent of pesticide contamination at this area because several pesticides were identified in a surface soil sample collected in the northwest corner of the site. • Additional groundwater samples should be analyzed for pesticides. • Groundwater should be resampled for VOCs to confirm the Phase I analytical results because VOCs identified in soil-gas and subsurface soil samples were not identified in groundwater. • Groundwater flow direction should be reevaluated prior to sampling because the reported groundwater flow is inconsistent with regional patterns and cannot be explained by local topographic controls. • A risk assessment should be performed for chemicals of concern identified at this site following sampling and reassessment of background concentrations.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site 5: Electrical Shop, Building 4	• PCB screening of surface soil indicated three detections of PCBs at concentrations greater than 5 mg/kg, but less than 50 mg/kg. Confirmatory laboratory analysis indicated confirmation of PCBs at a concentration of less than the 1 mg/kg action level for soil in residential areas. • Low concentrations of pesticides were identified in 2 surface soil samples submitted for confirmatory analysis. The pesticides are probably related to the basewide use of pesticides. • The pesticides DDT and DDE were identified in 1 subsurface soil sample. The pesticides are probably related to the basewide use of pesticides. • TPH (diesel fuel) was detected in subsurface soil samples collected from 1 boring. The TPH concentration in 1 sample exceeded the IDEM action level for TPH in soil at UST sites.	• Additional sampling should be conducted to evaluate the extent of TPH at the site and to evaluate whether groundwater has been affected because TPH concentrations in a subsurface soil sample exceeded the IDEM action level for TPH in soil at UST sites.
EI Site 6: Former Coal Storage Yard, Building 2	• Metals exceeding IDEM background concentrations were identified in the 10 surface soil samples collected at the site. Seventeen metals exceeded IDEM background, with selenium, thallium, and zinc being the most frequently detected above IDEM background. These metals are naturally occurring, but may also be related to the storage of coal at the site. • Metals exceeding IDEM background concentrations were detected in samples from 7 of the 11 shallow subsurface soil samples collected at the site. Four metals and cyanide exceeded IDEM background, with sodium and selenium being the most frequently detected metals above IDEM background. These metals are naturally occurring, but may also be related to the storage of coal at the site.	• Additional surface and subsurface soil sampling for PAH compounds should be conducted because PAH compounds are commonly associated with coal, and these compounds were not included in the Phase I analytical program for this site. • A risk assessment should be performed for identified PAH compounds and metals (exceeding background concentrations) to evaluate potential risks associated with the site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM18: Pesticide Mixing and Storage Areas, DIS Maintenance Storage Shed, Building 27	• Standing water in the basement of Building 27 may be in hydraulic connection with groundwater outside the building. • Pumping of standing water from the basement of Building 27 into the adjacent yard may have transported pesticides and herbicides into the yard area. • Thirteen metals including cadmium, chromium, and lead were detected in surface-water samples collected from the standing water in EI Site SM18. Sixteen metals and cyanide were detected in sediment samples collected from EI Site SM18. Arsenic had a concentration of 910 mg/kg for 1 sediment sample. The presence of some of these metals may be related to the use of the building for pesticide storage. • Eleven pesticides and herbicides were detected in surface-water samples collected from the standing water in EI Site SM18. The highest concentration was 10 mg/kg for both aldrin and DDD. • Twelve organic compounds consisting of pesticides and herbicides were detected in sediment samples collected from EI Site SM18. The highest concentration of these compounds was for dieldrin at 92 mg/kg.	• To assess the potential for pesticide-impacted soil near Building 27 because of past pesticide mixing practices, and because pesticide-impacted water from Building 27's basement was observed being pumped onto the ground surface, 4 surface soil samples and 4 subsurface soil samples should be collected at a depth of approximately 5 feet bgs. These samples should be analyzed for metals, pesticides, and herbicides. • The installation of 1 upgradient and 1 to 2 downgradient monitoring wells near Building 27 may be appropriate. Groundwater sampling and analysis should be performed to assess whether the building has had any impact on local groundwater quality. • If pesticide and herbicide constituents are identified in soil or groundwater, a risk assessment should be performed at the site. • The basement should be drained of water if the water is not in hydraulic connection with the groundwater. Any water pumped from the basement should be treated as a potentially hazardous substance and disposed of in accordance with applicable state and federal regulations. Water present in the basement of Building 27 should not be pumped onto the lawn due to the presence of contaminants in the water. If it appears that water in the basement is in hydraulic connection with groundwater, pumping of water is not recommended. The entrance to the basement should be secured and a warning sign should be posted in clear view so unauthorized personnel do not enter the basement and come in contact with contaminant-impacted water. • The basement should be thoroughly cleaned. The sludge and sediment at the bottom of the basement should be removed and disposed of properly. All used pesticide containers should be removed and disposed of properly. • The building should be considered for demolition, due to its poor current condition and contaminated basement. If the building is demolished, the rubble should be treated as potentially hazardous substances, and disposed of in accordance with applicable state and federal regulations.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM19: Pesticide Mixing and Storage Areas, Building 514	• Eight pesticides and 1 herbicide were detected in surface soil at 9 sampling locations. The alpha- and gamma-chlordanes were the most frequently detected pesticides with the highest detections.	• A baseline risk assessment is recommended to establish whether the detected pesticide and herbicide concentrations warrant remediation of soil in areas adjacent to Building 514.
EI Site SM20: Pesticide Mixing and Storage Areas, DIS Entomology, Building 605	• Surface soil concentrations of detected organics were reported for 11 organic compounds, including PCB-1260 and 10 pesticides and herbicides. PCB concentrations in surface soil samples were below the EPA (1990a) action level (10 ppm) for soil in industrial areas. • Organics were detected in surface soil samples located throughout the site, indicating that the extent has not been characterized. • Subsurface soil concentrations of detected organics were reported for 6 pesticides in samples from 2 of 4 borings, drilled with most of the detected pesticides confined to subsurface soil collected from 1 boring located north of the pesticide mixing and storage area. • Surface-water concentrations of organics were detected for 1 herbicide (2,4-D) in 1 surface-water sample from the downstream sampling location. • Three pesticides were detected in sediment samples collected from the downstream sampling location.	• Install monitoring wells; sample and analyze groundwater samples to evaluate the possible presence of constituents in groundwater. • Collect additional surface and subsurface soil samples to assess the extent of pesticide and herbicide contamination. • Conduct a risk assessment as part of the Phase II EI investigation. The purpose of the risk assessment is to evaluate the risk associated with pesticides and herbicides identified at the site.
EI Site SM21: Pesticide Mixing and Storage Areas, Golf Course Pesticide Mixing Area, Building 074	• Of 12 surface soil samples collected, 11 contained detectable concentrations of 1 or more pesticides or herbicides. With the possible exception of DDT, DDD, and DDE, the pesticides appear to be related to onsite mixing and storage activities. • Sediment concentrations of organics indicate the presence of 5 pesticides at both the upstream and downstream sediment sampling locations. Three pesticides (alpha-chlordane, gamma-chlordane, heptachlor epoxide) were detected in the downstream sample but not in the upstream sample. These pesticides were also identified in onsite surface soil samples. Two pesticides (DDE and DDT) were detected in the upstream sample but not in the downstream sample. The pesticides may result from the former basewide use of DDT.	• Collect additional surface and soil samples to assess extent of pesticides in these media. • Drill a limited number of soil borings and install and sample up to 4 monitoring wells to assess pesticides in subsurface soil and groundwater. • Conduct a risk assessment for chemicals of concern associated with the site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM22: Firing Range, Foreman Rifle Range, Near Buildings 811 and 812	• Surface soil concentrations of metals exceeded IDEM background concentrations in all 11 samples. The most frequently detected metals were lead and copper. These metals also had the highest concentrations above IDEM background, with maximum concentrations of 49,000 mg/kg and 3090 mg/kg, respectively. Observed lead concentrations exceed the EPA (1994c) recommended screening level for residential soil (400 ppm). The elevated concentrations of metals including antimony, copper, lead, and zinc in the surface soil sample is consistent with use of the site as a firing range. • Subsurface soil concentrations of metals exceeded IDEM background concentrations in samples collected from all 5 borings. Lead and copper were the most frequently detected metals, but the maximum concentrations (3920 mg/kg and 64.10 mg/kg, respectively) were lower than lead and copper concentrations in surface soil. • Surface-water concentrations for dissolved lead increased downstream of the firing range site. The observed concentration is below acute and chronic AWQC for lead in surface water. • Sediment concentrations of metals indicated elevated levels of 12 metals in both upstream and downstream samples. Downstream concentrations of metals such as iron, manganese, lead, and copper are higher than upstream concentration and may be the result of runoff from the adjacent bullet impact area of the firing range.	• Conduct field screening to delineate extent of elevated lead concentrations in surface soil. • Install monitoring wells and assess the affect of evaluated metals on local groundwater quality. • Conduct a risk assessment and ecological assessment to evaluate risks associated with chemicals of concern at this site. • Conduct an accelerated FS and implement interim remedial measures for the firing range backstop to remove the primary source of lead at the site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM23: Firing Range, State Police Pistol Range, Near Building 815	• Surface soil metals concentrations exceeded IDEM background concentrations in all 10 sampling locations. The most frequently detected metals were lead, copper, and thallium, and the metal with the highest concentrations above IDEM background was lead. Observed lead concentrations greatly exceed the EPA (1994c) recommended screening level for residential soil (400 ppm). Metals concentrations in the surface soil are consistent with site firing range activities. • Subsurface soil concentrations of metals exceeded IDEM background concentrations in samples collected from the 5 sampling locations. Lead and thallium were the most frequently detected metals, but were detected at lower concentrations than in surface soil. • Surface-water concentrations of 9 total and 10 dissolved metals were reported. Analyte concentrations were generally greater in the downstream sample then in the upstream sample. Total and dissolved lead concentrations at the downstream station exceed EPA (1986) chronic AWQC. • Sediment concentrations of metals indicated detections of 16 metals in both upstream and downstream samples. Downstream metals concentrations were higher than upstream concentrations.	• Conduct field screening to delineate the extent of elevated lead concentrations in surface soil. • Install monitoring wells and assess the effects of elevated metals on local groundwater quality. • Conduct a baseline risk assessment and ecological assessment to evaluate exposure pathways and associated risks in more detail. • Conduct an accelerated FS and implement interim remedial measures for firing range backstop to remove primary source of lead at the site.
EI Site SM24: Firing Range, Skeet/Rifle Range, Near Buildings 819 through 822	• Surface soil metals concentrations exceeded IDEM background concentrations in all 17 sampling locations. The most frequently detected metal and the metal with the highest concentrations above IDEM background is lead. Many of the lead concentrations identified at this site exceed the EPA (1994c) recommended screening level for residential soil (400 ppm). • Subsurface soil metals concentrations exceeded IDEM background concentrations in 6 sampling locations. Sodium and lead were the most frequently detected metals, but at lower concentrations than in surface soil reflecting the impact of firing range activities on primarily the surface soil.	• Conduct field screening to delineate the extent of elevated lead concentrations in surface soil including possible locations of the site formerly used as a rifle range. • Install monitoring wells and assess the effect of elevated metals on local groundwater quality. • Conduct a risk assessment to evaluate risks associated with chemicals of concern at this site. • Conduct an accelerated FS and implement interim remedial measures to remove the primary source of lead from the site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM25a: Historic Military Site - World War I-era entrenchment used for training activities	Based on the records review and site reconnaissance, there is no evidence to indicate that wastes were disposed of at the World War I-era entrenchment site (EI Site SM25a) or that hazardous waste or hazardous substances were released.	No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.
EI Site SM25b: Historic Military Site - World War I-era dump	• Information obtained from the records review revealed that surface debris (artifacts) were found during a 1983 archeological survey of this site; however, subsequent searches for artifacts failed because of possible grading of the site related to construction of the FBH golf course. • HLA's site reconnaissance did not reveal the presence of manmade surface or subsurface debris, or evidence that this site was used for disposal of refuse. • There was no evidence of buried debris detected during HLA's geophysical survey of this site. • Results of the investigation sampling revealed the following: - Cadmium, cobalt, mercury, lead, and zinc were detected in surface soil samples at concentrations that slightly exceeded IDEM background concentrations. The presence of these analytes is not believed to be related to known site-specific activities. - Twenty-two SVOC compounds, including several PAHs and TICs, were detected in 5 of the 6 surface soil samples with all of the PAH compounds detected only in a single sample at low concentrations. The presence of these analytes may have been the result of post activity at this site. - One pesticide (beta-benzenehexachloride) was detected at low concentrations in 1 sample at the site. This pesticide may be related to the basewide use of pesticides. - Four landfill parameters (ammonia, nitrite/nitrate-nonspecific, TOC, and total recoverable phenolics) were detected for this site. The presence of these analytes is not related to known site-specific activities.	• A risk assessment should be conducted to evaluate risks associated with chemicals of concern, including detected PAHs, at the site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM25c: Historic Military Site World War I-era dump	• Information obtained from the records review revealed that surface debris (artifacts) were found during a 1983 archeological survey of this site; however, subsequent searches for artifacts failed because of possible grading of the site related to construction of the FBH golf course. • The HLA site reconnaissance revealed that this site is beneath the current FBH golf course turf; artifacts were not located on the undisturbed surface, although glass bottle fragments were observed in excavated soil. • The geophysical survey indicated the presence of subsurface disturbances and several distinct anomalies. The subsurface disturbances were probably the result of increased soil moisture along a local drainage. The distinct anomalies are likely the result of buried metallic objects. • TVHC and VOCs were not detected in the limited quantity of soil-gas samples collected from this site. • Several metals were detected above IDEM background concentrations in the subsurface soil samples. The presence of the elevated metals concentrations in the subsurface may not be associated with site-related activities. • Organic compounds detected in the subsurface soil samples collected from this site may be laboratory artifacts or TICs. The TICs are primarily hydrocarbons and were detected in fill material. • Several landfill parameters including ammonia, chloride, sulfate, nitrite/nitrate, and TOC were detected in subsurface soil. These analytes are common soil constituents and their presence was not unexpected.	• A baseline risk assessment should be conducted to evaluate risks associated with chemicals of concern at the site.
EI Site SM25d: Historic Military Site - Agricultural dump (Circa 1900) and World War II-era dump	On the basis of the records review and site reconnaissance, only household debris has been identified at the site. Dump materials identified in the 1992 survey (automobile bumpers, fenders, tires, etc.) have apparently been removed. There is no evidence to indicate that this site has released hazardous substances into the environment, because the minimal debris observed at this site during the Phase I EI appears to be household related.	No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM25e: Historic Military Site - Pioneer Homestead and World War II-era dump	On the basis the records review and site reconnaissance, there is no evidence to indicate that hazardous materials or hazardous substances were disposed of at the site as waste material by the Army at this site, or that hazardous substances were released into the environment because the debris observed at this site appears to be household related.	No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.
EI Site SM25f: Historic Military Site - World War II-era dump	• The HLA site reconnaissance revealed that this site is beneath a paved parking lot south of Lord Hall Building. • The geophysical survey indicated the presence of four anomalies indicative of buried metal. • Low concentrations (<0.01 $\mu g/l$) of VOCs and TVH (<20 $\mu g/l$) were detected in the limited quantity of soil-gas samples collected from this site. • Ten metals exceeding IDEM background were detected in subsurface soil samples collected from this site. Metals are naturally occurring elements, and may not be related to disposal activities at the site. • Twenty-one organic compounds, including pesticides and PAH compounds were detected in the subsurface soil samples, collected at this site, composed primarily of fill. • Landfill parameters were detected in the subsurface soil samples collected from the 3 borings at this site. The detections of these landfill parameters is expected because the landfill parameters are common constituents in soil.	• Conduct a risk assessment to evaluate risks associated with chemicals of concern at the site.
EI Site SM25g: Historic Military Site World War I-era entrenchment used for training activities	On the basis of the records review and site reconnaissance, there is no evidence to indicate that hazardous materials or hazardous substances were disposed of by the Army as waste material at this site.	No further action is recommended for this site on the basis of the results of the records review and site reconnaissance.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM25h: Historic Military Site Military dump in use from 1930 to 1950.	• Information obtained from the records review revealed that this site served as a prehistoric campsite. During the approximate time period between 1930 and 1950, this site served as a dump. • The HLA site reconnaissance indicated the presence of construction debris on the ground surface along the edge of a bluff located at this site. • Twelve metals were detected in surface soil samples at concentrations that exceeded IDEM background concentrations. Lead concentrations were below EPA's (1994c) action level for soil in residential areas (400 ppm). Some of the metals identified may not be related to onsite dumping actions. • Primarily PAH and hydrocarbon compounds were detected in the 6 surface soil samples collected at this site; the extent of the organic compounds in surface soil has not been established. • Between 3 and 5 landfill parameters were detected in each soil sample. The detections of landfill parameters were anticipated because many of the landfill parameters are common soil constituents.	• Collect additional surface and subsurface soil samples to assess the extent of the area where surface soil PAHs have been identified. • Conduct a risk assessment to evaluate risks associated with chemicals of concern at the site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site 25i: Historic Military Site Water treatment facility once located nearby	• Information obtained from the records review revealed that a water treatment facility was once located near this site. • The HLA site reconnaissance did not reveal the presence of manmade surface debris or evidence of unusual ground features. • The geophysical survey revealed an area of disturbed soil possibly indicative of subsurface disposal or fill material. • Cobalt, sodium, and zinc were detected in 1 surface soil sample each at concentrations slightly above IDEM background. These concentrations reflect soil heterogeneity and are not site related. • PAH compounds were detected in 1 of the 6 surface soil samples collected at this site at concentrations of less than 2 mg/kg and may be related to fill material placed at the site. The extent of the PAH compounds has not been determined. DDE and the TIC nonacosane were detected in all 6 samples at concentrations of less than 2 mg/kg. DDT and DDD were detected in 1 or more samples at concentrations of less than 0.1 mg/kg and is probably related to former basewide use of pesticides. • The landfill parameter analytes ammonia, nitrite/nitrate, and TOC were detected in all 6 surface soil samples. However, the detections and concentrations are likely not related to known site-specific activities.	• Additional surface and subsurface soil sampling should be conducted to assess the extent of PAH compounds at the site. • A risk assessment should be performed to evaluate risks associated with chemicals of concern at the site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM25j: Historic Military Site World War I-era military dump	• Information obtained from the records review indicated that this site served as a World War I-era dump site. A limited amount of surface debris has been recovered mostly in garden plots from this site. • The HLA site reconnaissance did not indicate the presence of manmade surface debris or evidence of unusual ground features. • The geophysical survey indicated 3 localized areas of shallow disturbed soil possibly indicative of subsurface disposal or fill material. • Copper and zinc were each detected in 3 surface soil samples at concentrations that exceeded the IDEM background concentration. Lead was identified as exceeding IDEM background in the surface samples; however, the concentrations were below the EPA (1994c) action level for soil in residential areas. The presence of metals is not related to known site-specific activities. • Twenty-three organic compounds including PAH, TIC, and pesticide compounds were detected in 1 or more of the 6 surface soil samples collected at this site at concentrations of less than 5 mg/kg. The presence of organic compounds may be related to site disposal activity. The extent of low-concentration organic compounds in surface soil has not been defined. • Landfill parameter analytes including ammonia and TOC were detected in 1 or more of the 6 surface soil samples collected at this site. The presence of landfill parameter analytes is not related to known site-specific activities.	• Conduct additional surface and subsurface soil sampling to assess the extent of PAH compounds at the site. • A risk assessment should be performed to evaluate risks associated with chemicals of concern at this site.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM25k: Historic Military Site - World War II-era military dump	• Information obtained from the records review indicated that this site served as a World War II - era dump. A limited amount of surface debris has been removed from this site. • The HLA site reconnaissance indicated household debris were dumped at this site. • Thirteen metals were detected at concentrations that exceeded IDEM background concentrations in each of the 6 surface soil samples collected at this site. Lead was identified in 4 samples at concentrations below the EPA (1994c) action level for residential soil. The relatively low metals concentrations exceeding IDEM background concentrations in soil samples may be related to natural heterogeneity. • Organic compounds including hydrocarbons and the herbicide 2,4-D were detected in each of 6 surface soil samples collected at this site at concentrations of less than or equal to 4 mg/kg. Low concentrations of hydrocarbons may be related to known site-specific activities. • Landfill parameters were detected in each of the surface samples collected at the site, although the detections of the landfill parameters are likely not related to known site-specific activities.	• Conduct a risk assessment to evaluate risks associated with chemicals of concern at the site.
EI Site SM25l: Historic Military Site Former grenade training course	Based on the limited records review there is insufficient evidence to assess whether hazardous substances were disposed of at this site.	• Comprehensive records search to include a review of available aerial photography • UXO survey to assess the presence of subsurface UXO • Surface and subsurface soil sample collection and analysis of soil samples for metals and explosives

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM26: Former Sewage Treatment Plant (West of Building 674)	• Walls between the sewage treatment contact beds were located. Neither the former septic tank nor former sludge bed were detected using geophysical methods. • Five high-amplitude EM anomalies indicating buried metal objects within the buried sewage treatment contact beds were observed. • An area of medium-amplitude EM anomalies was observed that may represent clayey fill material.	• Collect surface soil samples in the areas of geophysical anomalies or former sewage treatment contact beds septic tanks and drying beds if these locations can be assessed. Samples will be collected to assess concentrations of metals and organics in surface soil that may be caused by former site activity. Analyze samples for metals, SVOCs, pesticides, and herbicides. • Drill soil borings and collect subsurface soil samples in the areas of geophysical anomalies or former sewage contact beds, septic tanks and drying beds if these locations can be assessed. Samples will be collected to assess concentrations of metals and organics in subsurface soil that may be the result of former site activity. Analyze samples for metals, VOCs, SVOCs, pesticides, and herbicides. • On the basis of analytical data from soil samples, consider the need for monitoring wells upgradient and downgradient from the site.
EI Site SM27: former Sewage Treatment Plant (North of Building 509)	The geophysical survey performed at the site located an area of possible construction debris that may be remnants of the former structure of the treatment plant and localized disturbances that may indicate remnants of a former structure.	• Drill up to 5 borings. Drill 1 of these borings to 5 feet bgs at each of the two localized areas of shallow soil disturbance. Drill up to 3 of these borings to 5 feet bgs in the area containing widespread metallic debris. Collect one subsurface soil from each boring. Analyze the subsurface soil samples for VOCs, SVOCs, metals, pesticides, and herbicides.
EI Site SM28: Wash Racks, Grease Racks, Oil/Water Separators	• Seventeen wash racks, grease racks, oil/water separators, or floor drains discharge to a POTW • One grease rack discharges to the ground surface • Three wash racks or floor drains discharge to a storm sewer • One floor drain and 1 wash rack have no identified discharge connection • Two wash racks are pumped out	• Drill borings and collect subsurface soil samples in areas adjacent to oil/water separators where leaks or spills are suspected to have occurred. • For those wash racks, grease racks, and/or oil/water separators that do not discharge to POTW (i.e., the discharge is to a nearby ditch, stream, or a storm drain) collect 2 sediment samples - 1 upstream and 1 downstream of the outfall. • Conduct a risk assessment and evaluate risks associated with chemicals of concern at the sites.

Table 5.1 (continued)

Site Identification	Conclusions	Recommendations
EI Site SM29: Patriotic Site	Test-pit excavation and sampling at the site indicated low concentrations of fuel-related hydrocarbons were present in the near-surface soil.	• Conduct a risk screening for the site following the ASTM (1994) emergency standard for Petroleum Release Sites. • If the risk screening identifies a health concern, remove and dispose of soil containing fuel-related hydrocarbon compounds.

ASTM	American Society for Testing and Materials
AWQC	Ambient water quality criteria
bgs	Below ground surface
EI	Environmental investigation
EM	Electromagnetic
EPA	U.S. Environmental Protection Agency
FBH	Fort Benjamin Harrison
FS	Feasibility study
IDEM	Indiana Department of Environmental Management
mg/kg	Milligrams per kilogram
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethane
POTW	Publicly owned treatment works
ppm	Parts per million
SVOC	Semivolatile organic compound
TCE	Trichloroethene
TIC	Tentatively identified compound
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon
TVH	Total volatile hydrocarbon
UST	Underground storage tank
UXO	Unexploded ordnance
VOC	Volatile organic compound
μg/l	Micrograms per liter

6.0 GLOSSARY

1,1-DCA	1,1-Dichloroethane
1,1,1-TCA	1,1,1-Trichloroethane
1,2-DCE	1,2-Dichloroethene
AA	Alternatives analysis
AEHA	U.S. Army Environmental Hygiene Agency
ARCOM	Army Reserve Command
AREE	Area requiring environmental evaluation
Army	U.S. Department of the Army
AWQC	Ambient water quality criteria
bgs	Below ground surface
BNA	Base-neutral and acid-extractable compound
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act
COE	U.S. Army Corps of Engineers
DDD	2,2-bis(p-Chlorophenyl)-1,1-dichloroethane
DDE	2,2-bis(p-Chlorophenyl)-1,1-dichloroethene
DDT	2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane
DMP	Data Management Plan
DPCA	Directorate of Personnel and Community Activities
DQO	Data quality objectives
DRMO	Defense Reutilization and Marketing Office
ECD	Electron capture detector
EI	Environmental Investigation
EIS	Environmental impact statement
EM	Electromagnetic

EPA	U.S. Environmental Protection Agency
ERC	ERC Environmental and Engineering Services
ESE	Environmental Science and Engineering, Inc.
FBH	Fort Benjamin Harrison
FID	Flame ionization detector
GC	Gas chromatograph
gpm	Gallons per minute
GPR	Ground penetrating radar
HLA	Harding Lawson Associates
IDEM	Indiana Department of Environmental Management
IDNR	State of Indiana Department of Natural Resources
IWC	Indianapolis Water Company
LUST	Leaking underground storage tank
MCL	Maximum contaminant level
mg/l	Milligrams per liter
mg/kg	milligrams per kilogram
mgd	Million gallons per day
MS	Matrix spike
MSD	Matrix spike duplicate
NGVD	National Geodetic Vertical Datum of 1929
OCP	Organochlorine pesticide
OVA	Organic vapor analyzer
PA	Preliminary assessment
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PID	Photoionization detector

POL	Petroleum, oils, and lubricants
POTW	Publicly owned treatment work
ppm	Parts per million
PVC	Polyvinyl chloride
PX	Post exchange
RCRA	Resource Conservation and Recovery Act
RD-400	Radio frequency pipe and cable locator
RFA	Resource Conservation and Recovery Act Facility Assessment
RFI	Resource Conservation and Recovery Act Facility Investigation
RI/FS	Remedial investigation/feasibility study
RPD	Relative percent difference
SAIC	Science Applications International Corporation
SDWA	Safe Drinking Water Act
SI	Site investigation
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TCE	Trichloroethene
TCL	Target compound list
TDS	Total dissolved solids
TEPS	Total Environmental Program Support
TIC	Tentatively identified compound
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon
TRADOC	U.S. Army Training and Doctrine Command
TSP	Technical Sampling Plan
TVH	Total volatile hydrocarbon
USAEC	U.S. Army Environmental Center

USASSC	U.S. Army Soldier Support Center
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground storage tank
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
VOC	Volatile organic compound
Weston	Roy F. Weston, Inc.
°C	Degrees Celsius
°F	Degrees Fahrenheit
μg/l	Micrograms per liter
μmhos/cm	Micromhos per centimeter

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A	B

BENCH MARKS
NAVD 1929 DATUM

1

B.M. FH-1 'N-235-1947'
A STANDARD USC&GS DISK SET IN CONCRETE. LOCATED 40 FT. WE
AVENUE) AND 45 FT. NORTH OF CENTERLINE OF CONRAIL RAILROA

B.M. FH-3 'FINANCE 1981'
A STANDARD C.O.E. DISK SET IN A CONCRETE POST. LOCATED 75
OF HERBERT LORD ROAD IN LINE WITH THE FINANCE CENTER BUIL

B.M. FH-4 'POOL 1981'
A STANDARD C.O.E. DISK SET IN CONCRETE. LOCATED 45 FT. SO
TRAILER COURT ROAD AT THE S.W. CORNER OF THE RV/BOAT STOR

2

B.M. FH-6 'FRANKLIN 1981'
A STANDARD C.O.E. DISK SET IN THE CENTER OF CONCRETE HEAD
NORTH OF CENTERLINE 56TH STREET (AULTMAN AVENUE) AND 400
ROAD.

B.M. FH-8 '4'
BRASS DISK ON NORTHWEST END OF BRIDGE FOR BOY SCOUT ROAD (
OF 6 IN. CURB.

B.M. FH-10 'RANGE 1981'
A STANDARD C.O.E. DISK SET IN N.W. WINGWALL OF BRIDGE FOR
LAWRENCE CREEK. LOCATED 15 FT. NORTH OF ROAD CENTERLINE AN
GLENN ROAD.

3

B.M. FH-15 '1947-V-236
A STANDARD USC&GS DISK SET IN CONCRETE. LOCATED BEHIND THE
BENJAMIN HARRISON ON THE WEST SIDE OF LEE ROAD. 1/4 MILE S

B.M. FH-16 'WATER TOWER 1966'
A STANDARD C.O.E. DISK SET IN THE S.W. CORNER OF THE CENTE
AT THE N.E. CORNER OF LEE ROAD AND 56TH STREET.

B.M. FH-17 'HAWLEY 1981'
A STANDARD C.O.E. DISK SET IN CONCRETE. LOCATED 62 FT. NOR
(SHAFTER ROAD) AND 48 FT. WEST OF ROAD TO HAWKINS RECREATI

4

B.M. FH-18 'P.E.C.-2-1965'

B | C 2 | D |

IM

ED 40 FT. WEST OF POST ROAD (GREENE
RAIL RAILROAD TRACKS.
ELEV. 871.05

. LOCATED 75 FT. EAST OF CENTERLINE
CENTER BUILDING.
ELEV. 863.89

:D 45 FT. SOUTH OF CENTERLINE OF
IV/BOAT STORAGE AREA.
ELEV. 840.87

INCRETE HEADWALL LOCATED 50 FT. •
'E) AND 400 FT. • EAST OF FRANKLIN
ELEV. 843.05

SCOUT ROAD OVER FALL CREEK ON TOP
ELEV. 761.33

BRIDGE FOR SHAFTER ROAD OVER
:NTERLINE AND 100 FT. EAST OF
ELEV. 762.40

) BEHIND THE ENTRANCE WALL TO FORT
1/4 MILE SOUTH OF 63RD STREET.
ADJ. ELEV. 843.07

IF THE CENTER LEG OF WATER TOWER
ADJ. ELEV. 848.82

62 FT. NORTH OF 59TH STREET
NS RECREATION AREA.
ELEV. 846.16

STATION NAME	NORTH LATITUDE	LO
MW 1	39°51'32.817"	86°0
MW 2	39°51'39.918"	86°0
MW 3	39°51'24.636"	86°0
MW 4	39°51'34.769"	86°01
MW 5	39°51'21.249"	86°01
MW 6	39°51'21.719"	86°01
MW 7	39°51'11.637"	86°00
MW 8	39°51'13.353"	86°00
MW 9	39°51'14.194"	86°00
MW 10	39°51'14.866"	86°00
MW 11	39°51'14.263"	86°00
MW 12	39°52'08.039"	86°01'
MW 13	39°52'12.041"	86°01'
MW 14	39°52'12.894"	86°01'
MW 15	39°52'12.891"	86°01'
MW 16	39°52'09.466"	86°00'
MW 17	39°52'03.760"	86°00'

PREVIOUSLY EXISTING MONITORING WELLS

1927 DATUM

WEST LONGITUDE	UTMS NORTHING (METER)	UTMS EASTING (METER)	ELEVATION	COMMENT
86°01'25.244"	4412366.914	583512.419	849.34	N.EDGE OF METAL FLANGE ATTACHED TO P
			847.12	GROUND 4.0 FT. N'LY. OF WELL
86°01'33.701"	4412583.666	583309.072	828.66	N.TOP OF PVC
			825.27	GROUND 4.0 FT. N'LY. OF WELL
86°01'35.921"	4412111.933	583261.452	836.05	N. EDGE OF METAL FLANGE ATTACHED TO
			832.62	GROUND 4.0 FT. N'LY. OF WELL
86°01'35.504"	4412424.462	583267.966	844.85	N. EDGE OF METAL FLANGE ATTACHED TO
			842.01	GROUND 4.0 FT. N'LY. OF WELL
86°01'33.615"	4412008.107	583317.394	841.55	N. EDGE OF METAL FLANGE ATTACHED TO
			839.45	GROUND 4.0 FT. N'LY. OF WELL
86°01'24.567"	4412024.954	583532.234	864.06	TOP OF PVC. NO CAP
			865.23	N. RIM OF PROTECTIVE HOUSING
			861.79	GROUND 1.0 FT. N. OF CASING
86°00'32.645"	4411727.690	584769.452	864.75	TOP OF PVC. NO LOCK OR CAP
			864.94	N. RIM OF PROTECTIVE HOUSING
			863.29	GROUND 1.0 FT. N. OF CASING
86°00'36.737"	4411779.534	584671.619	866.86	TOP OF PVC. BROKEN LOCK & HINGE.
			867.14	N. RIM OF PROTECTIVE HOUSING
			864.83	GROUND 1.0 FT. N. OF CASING
86°00'36.638"	4411805.490	584673.687	865.85	TOP OF PVC. WELL IN GOOD COND.
			866.05	N. RIM OF PROTECTIVE HOUSING
			864.37	GROUND 1.0 FT. N. OF CASING
86°00'35.916"	4411826.380	584690.624	865.53	TOP OF PVC. WELL IN GOOD COND.
			865.97	N. RIM OF PROTECTIVE HOUSING
			863.96	GROUND 1.0 FT. N. OF CASING
86°00'33.282"	4411808.505	584753.424	865.11	TOP OF PVC. NO LOCK OR CAP
			865.37	N. RIM OF PROTECTIVE HOUSING
			863.24	GROUND 1.0 FT. N. OF CASING
86°01'32.817"	4413450.854	583320.635	774.96	TOP OF PVC. WELL IN GOOD COND.
			775.27	N. RIM OF PROTECTIVE HOUSING
			774.07	GROUND 1.0 FT. N. OF CASING
86°01'33.219"	4413574.152	583309.731	755.23	TOP OF PVC. WELL IN GOOD COND.
			756.08	N. RIM OF PROTECTIVE HOUSING
			753.11	GROUND 1.0 FT. N. OF CASING
86°01'35.066"	4413599.953	583265.573	753.45	TOP OF PVC. WELL IN GOOD COND.
			754.24	N. RIM OF PROTECTIVE HOUSING
			751.99	GROUND 1.0 FT. N. OF CASING
86°01'31.483"	4413600.790	583350.703	754.17	TOP OF PVC. WELL IN GOOD COND.
			755.06	N. RIM OF PROTECTIVE HOUSING
			752.17	GROUND 1.0 FT. N. OF CASING
86°00'00.346"	4413519.108	585517.029	841.92	TOP OF PVC. WELL IN GOOD COND.
			842.05	N. RIM OF PROTECTIVE HOUSING
			841.07	GROUND 1.0 FT. N. OF CASING
86°00'03.798"	4413342.282	585436.979	847.09	TOP OF PVC. WELL IN GOOD COND.
			847.50	N. RIM OF PROTECTIVE HOUSING

G | H | 4 I |

MONITORING WELLS

1927 [

	STATION NAME	NORTH LATITUDE	WEST LONGITUDE	UTMS NORTHING (METER)
TTACHED TO PVC CASING WELL				
WELL	EI001MW001	39°51'29.971°	86°01'16.519°	4412281.443
ATTACHED TO PVC CASING WELL	EI001MW002	39°51'31.582°	86°01'16.960°	4412331.201
ATTACHED TO PVC CASING WELL				
ATTACHED TO PVC CASING WELL	EI001MW003	39°51'31.879°	86°01'17.981°	4412339.911
SING ING AP	EI001MW004	39°51'30.880°	86°01'18.300°	4412309.201
SING ING HINGE.	EI002MW001	39°51'36.081°	86°00'24.221°	4412483.546
ISING ING COND.	EI002MW002	39°51'37.458°	86°00'25.618°	4412525.618
ISING ING COND.	EI002MW003	39°51'37.286°	86°00'26.540°	4412520.062
ISING ING AP	EI002MW004	39°51'36.660°	86°00'26.845°	4412500.593
SING ING COND.	EI003MW001	39°51'32.744°	86°00'44.914°	4412375.217
SING ING COND.	EI003MW002	39°51'33.285°	86°00'45.825°	4412391.649
SING ING COND.	EI003MW003	39°51'31.258°	86°00'46.268°	4412329.022
SING ING COND.	EI003MW004	39°51'32.379°	86°00'45.531°	4412363.790
SING ING COND.	EI004MW001	39°51'24.238°	86°00'34.158°	4412115.784
SING ING COND.	EI004MW002	39°51'24.906°	86°00'36.853°	4412135.679
SING	EI004MW003	39°51'26.598°	86°00'34.437°	4412188.186

I J I K 5

RING WELLS INSTALLED BY HLA

1927 DATUM

UTMS RTHING METER)	UTMS EASTING (METER)	ELEVATION	COMMENT
281.443	583720.691	856.96	N. TOP OF PVC
		857.16	N. RIM OF PROTECTIVE HOUSING
		854.45	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
331.001	583709.661	851.99	N. TOP OF PVC
		852.37	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
		852.27	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
339.911	583685.313	852.19	N. TOP OF PVC
		852.46	N. RIM OF PROTECTIVE HOUSING
		850.07	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
309.001	583678.064	852.00	N. TOP OF PVC
		852.54	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
		852.46	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
483.546	584961.267	856.60	N. TOP OF PVC
		856.96	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
		856.91	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
525.618	584927.601	856.98	N. TOP OF PVC
		857.30	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
		857.24	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
520.062	584905.743	856.82	N. TOP OF PVC
		857.04	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
		857.05	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
500.693	584898.718	855.93	N. TOP OF PVC
		856.21	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
		856.16	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
375.217	584470.727	843.45	N. TOP OF PVC
		843.82	N. RIM OF PROTECTIVE HOUSING
		841.15	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
391.649	584448.875	843.53	N. TOP OF PVC
		843.87	N. RIM OF PROTECTIVE HOUSING
		841.23	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
329.022	584439.058	853.42	N. TOP OF PVC
		853.68	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
		853.68	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
363.790	584456.190	853.76	N. TOP OF PVC
		853.89	N. RIM OF PROTECTIVE HOUSING
		851.92	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
2115.784	584729.203	859.15	N. TOP OF PVC
		859.41	N. RIM OF PROTECTIVE HOUSING
		857.25	GROUND 4.0 FT. SOUTH OF PROTECTIVE HOUSING
2135.679	584664.929	861.54	N. TOP OF PVC
		861.69	N. RIM OF PROTECTIVE HOUSING
		859.31	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
2188.486	584721.765	861.16	N. TOP OF PVC

B.M. FH-17 'HAWLEY 1981'
A STANDARD C.O.E. DISK SET IN CONCRETE. LOCATED 62 FT. NORTH OF 59TH STREET (SHAFTER ROAD) AND 48 FT. WEST OF ROAD TO HAWKINS RECREATION AREA.
ELEV. 846.

B.M. FH-18 'P.E.C.-2-1965'
A STANDARD C.O.E. DISK SET IN A CONCRETE HEADWALL. LOCATED 45 FT. WEST OF CENTERLINE OF WALTER REED ROAD AND 200 FT. SOUTH OF BEAUMONT ROAD.
ELEV. 851.

B.M. FH-19 'P.E.C. 2-1965'
A STANDARD C.O.E. DISK SET IN CENTER OF CONCRETE HEADWALL LOCATED 25 FT. WEST LEE ROAD AND 25 FT. SOUTH OF OTIS AVENUE.
ADJ. ELEV. 861.

B.M. FH-20 ' BM 45 1966'
A STANDARD C.O.E. DISK SET VERTICALLY IN FACE OF BUILDING #45. LOCATED ON NOR FACE OF BUILDING NEAR N.E. CORNER AND 18 FT. SOUTH OF CENTERLINE HAWKINS ROAD
ELEV. 863.

BASELINES AND CONTROL POINTS

AREA	MSE NO.	NORTHING	EASTING	LATITUDE	LONGITUDE	
FBH25F	501	859811.903	405169.902	39°51'37.569"	86°00'16.070"	0
FBH25F	502	859912.156	405166.200	39°51'38.560"	86°00'16.122"	1
FBH25F	503	859939.730	404964.955	39°51'38.825"	86°00'18.704"	N
FBH25F	504	859804.277	404969.960	39°51'37.486"	86°00'18.634"	0
FBH27	505	860988.384	404986.713	39°51'49.189"	86°00'18.476"	E
FBH27	506	861108.329	404980.722	39°51'50.375"	86°00'18.559"	E
FBH29	507	856243.627	401011.032	39°51'02.146"	86°01'09.221"	N
FBH29	508	856245.787	400999.479	39°51'02.166"	86°01'09.369"	N
FBH29	509	856240.156	400998.279	39°51'02.111"	86°01'09.384"	S
FBH29	510	856238.205	401010.420	39°51'02.092"	86°01'09.228"	S
FBH17	511	861440.227	405503.377	39°51'53.674"	86°00'11.872"	F
FBH17	512	861438.832	405655.595	39°51'53.666"	86°00'09.920"	F
FBH17	513	861714.755	405713.914	39°51'56.395"	86°00'09.186"	2
FBH17	514	861799.766	405514.602	39°51'57.228"	86°00'11.746"	[illegible]

9

I STREET	MW 16	39°52′09.466"	86°00′00.346"	4413519.10
LEV. 846.16	MW 17	39°52′03.760"	86°00′03.798"	4413342.28
:ST OF	MW 18	39°51′57.949"	86°00′03.944"	4413163.09
LEV. 851.10	MW 19	39°51′52.866"	86°00′03.844"	4413006.40
i FT. WEST OF				
LEV. 861.78	MW 20	39°51′56.088"	85°59′53.059"	4413108.61
'ED ON NORTH	MW 21	39°51′55.494"	85°59′43.960"	4413092.71
'KINS ROAD.				
:V. 863.24	MW 22	39°51′54.459"	85°59′37.802"	4413062.47
	MW 23	39°51′51.703"	85°59′30.359"	4412979.49
	MW 24	39°52′02.596"	86°00′10.323"	4413304.68
	MW 25	39°51′55.439"	85°59′53.467"	4413088.49
	LRC1	39°51′26.425"	86°00′16.395"	4412187.90
	LRC2	39°51′26.303"	86°00′14.103"	4412184.74
	LRC3	39°51′27.400"	86°00′16.173"	4412218.02
	LRC4	39°51′27.674"	86°00′13.132"	4412227.27

)E	COMMENT
070"	0·00N 2·00E PAINTED ON ASPHALT
122"	1·00N 2·00E PAINTED ON ASPHALT
704"	NW COR. TRASH AREA. PARK LOT ANGLE
634"	0·00N 0·00E PAINTED ON ASPHALT
476"	E. FACE POWER POLE
559"	E. FACE POWER POLE
221"	NE (2 X 2 W. HUB)
369"	NW (2 X 2 W. HUB)
384"	SW (2 X 2 W. HUB)
228"	SE (2 X 2 W. HUB)
872"	PINK FLAG
920"	PINK FLAG
186"	2 X 2 W. HUB
746"	2 X 2 W. HUB

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			752.17	GROUND 1.0 FT. N. OF CASING
86°00'00.346"	4413519.108	585517.029	841.92	TOP OF PVC. WELL IN GOOD COND.
			842.05	N. RIM OF PROTECTIVE HOUSING
			841.07	GROUND 1.0 FT. N. OF CASING
86°00'03.798"	4413342.282	585436.979	847.09	TOP OF PVC. WELL IN GOOD COND.
			847.50	N. RIM OF PROTECTIVE HOUSING
			845.36	GROUND 1.0 FT. N. OF CASING
86°00'03.944"	4413163.097	585435.527	845.28	TOP OF PVC. LOCK IS ON GROUND
			845.51	N. RIM OF PROTECTIVE HOUSING
			845.38	GROUND 1.0 FT. N. OF CASING
86°00'03.844"	4413006.408	585439.633	835.59	TOP OF PVC. LOCK IS BROKEN
			836.03	N. RIM OF PROTECTIVE HOUSING
			835.60	GROUND 1.0 FT. N. OF CASING
85°59'53.059"	4413108.618	585694.775	845.96	TOP OF PVC. WELL IN GOOD COND.
			846.62	N. RIM OF PROTECTIVE HOUSING
			844.01	GROUND 1.0 FT. N. OF CASING
85°59'43.960"	4413092.713	585911.162	846.68	TOP OF PVC. WELL IN GOOD COND.
			846.72	N. RIM OF PROTECTIVE HOUSING
			845.43	GROUND 1.0 FT. N. OF CASING
85°59'37.802"	4413062.478	586057.827	849.08	TOP OF PVC. LOCK IS BROKEN
			849.60	N. RIM OF PROTECTIVE HOUSING
			847.81	GROUND 1.0 FT. N. OF CASING
85°59'30.359"	4412979.498	586235.610	849.50	TOP OF PVC. WELL IN GOOD COND.
			850.67	N. RIM OF PROTECTIVE HOUSING
			848.15	GROUND 1.0 FT. N. OF CASING
86°00'10.323"	4413304.681	585282.372	850.44	TOP OF PVC. WELL IN GOOD COND.
			850.84	N. RIM OF PROTECTIVE HOUSING
			848.74	GROUND 1.0 FT. N. OF CASING
85°59'53.467"	4413088.498	585685.307	843.56	TOP OF PVC. WELL IN GOOD COND.
			843.69	N. RIM OF PROTECTIVE HOUSING
			842.19	GROUND 1.0 FT. N. OF CASING
86°00'16.395"	4412187.905	585150.532	865.28	GROUND. ABANDONED LOCATION
86°00'14.103"	4412184.747	585205.029	865.23	GROUND. ABANDONED LOCATION
86°00'16.173"	4412218.027	585155.456	864.24	GROUND. ABANDONED LOCATION
86°00'13.132"	4412227.275	585227.638	863.52	GROUND. ABANDONED LOCATION

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FT. N. OF CASING
WELL IN GOOD COND.
ROTECTIVE HOUSING
FT. N. OF CASING
WELL IN GOOD COND.
ROTECTIVE HOUSING
FT. N. OF CASING
LOCK IS ON GROUND
ROTECTIVE HOUSING
FT. N. OF CASING
LOCK IS BROKEN
ROTECTIVE HOUSING
FT. N. OF CASING
WELL IN GOOD COND.
ROTECTIVE HOUSING
FT. N. OF CASING
WELL IN GOOD COND.
ROTECTIVE HOUSING
FT. N. OF CASING
LOCK IS BROKEN
PROTECTIVE HOUSING
FT. N. OF CASING
WELL IN GOOD COND.
PROTECTIVE HOUSING
FT. N. OF CASING
WELL IN GOOD COND.
PROTECTIVE HOUSING
FT. N. OF CASING
WELL IN GOOD COND.
PROTECTIVE HOUSING
FT. N. OF CASING
NDONED LOCATION
NDONED LOCATION
NDONED LOCATION
NDONED LOCATION

EI004MW002	39°51'24.906"	86°00'36.853"	4
EI004MW003	39°51'26.598"	86°00'34.437"	4
EI004MW004	39°51'26.819"	86°00'36.697"	4
SM008MW001	39°51'26.054"	86°00'12.915"	
SM008MW002	39°51'28.507"	86°00'13.086"	
SM008MW003	39°51'28.590"	86°00'15.468"	
SM008MW004	39°51'27.276"	86°00'17.848"	
SM011MW001	39°52'12.227"	86°01'37.075"	
SM8KGMW001	39°51'01.490"	86°01'06.141"	
SM8KGMW002	39°51'01.218"	86°00'40.392"	
SM8KGMW003	39°51'08.684"	86°00'20.625"	
SM8KGMW004	39°51'18.742"	86°00'01.353"	
SM8KGMW005	39°51'32.009"	85°59'36.448"	
SM8KGMW006	39°52'13.625"	86°00'00.546"	
SM8KGMW007	39°51'53.763"	85°59'30.955"	

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				859.41	N. RIM OF PROTECTIVE HOUSING
				857.25	GROUND 4.0 FT. SOUTH OF PROTECTIV
•	86°00'36.853"	4412135.679	584664.929	861.54	N. TOP OF PVC
				861.69	N. RIM OF PROTECTIVE HOUSING
				859.31	GROUND 4.0 FT. N. OF PROTECTIVE H
•	86°00'34.437"	4412188.486	584721.765	861.16	N. TOP OF PVC
				861.35	N. RIM OF PROTECTIVE HOUSING
				858.79	GROUND 4.0 FT. N. OF PROTECTIVE H
•	86°00'36.697"	4412194.706	584667.973	858.58	N. TOP OF PVC
				858.89	N. RIM OF FLUSH MOUNT PROTECTIVE
				858.79	GROUND 1.0 FT. N. OF PROTECTIVE H
•	86°00'12.915"	4412177.393	585233.339	867.63	N. TOP OF PVC
				867.89	N. RIM OF PROTECTIVE HOUSING
				865.37	GROUND 4.0 FT. N. OF PROTECTIVE H
'•	86°00'13.086"	4412252.957	585228.447	865.92	N. TOP OF PVC
				866.10	N. RIM OF PROTECTIVE HOUSING
				863.65	GROUND 4.0 FT. N. OF PROTECTIVE H
)•	86°00'15.468"	4412254.892	585171.819	866.61	N. TOP OF PVC
				866.88	N. RIM OF PROTECTIVE HOUSING
				864.41	GROUND 4.0 FT. N. OF PROTECTIVE H
;•	86°00'17.848"	4412213.749	585115.701	867.54	N. TOP OF PVC
				867.81	N. RIM OF PROTECTIVE HOUSING
				865.28	GROUND 4.0 FT. N. OF PROTECTIVE H
7•	86°01'37.075"	4413578.875	583218.074	754.51	N. TOP OF PVC
				754.79	N. RIM OF PROTECTIVE HOUSING
				752.00	GROUND 5.0 FT. N. OF PROTECTIVE I
0•	86°01'06.141"	4411406.091	583976.918	869.94	N. TOP OF PVC
				869.96	N. RIM OF PROTECTIVE HOUSING
				867.68	GROUND 5.0 FT. N. OF PROTECTIVE I
3•	86°00'40.392"	4411404.456	584588.920	869.33	N. TOP OF PVC
				869.17	N. RIM OF PROTECTIVE HOUSING
				867.22	GROUND 5.0 FT. N. OF PROTECTIVE
4•	86°00'20.625"	4411639.818	585056.096	865.20	N. TOP OF PVC
				865.36	N. RIM OF PROTECTIVE HOUSING
				862.86	GROUND 4.0 FT. N. OF PROTECTIVE
2•	86°00'01.353"	4411955.029	585510.588	863.31	N. TOP OF PVC
				863.23	N. RIM OF PROTECTIVE HOUSING
				861.39	GROUND 5.0 FT. N. OF PROTECTIVE
9•	85°59'36.448"	4412370.702	586097.783	857.84	N. TOP OF PVC
				857.65	N. RIM OF PROTECTIVE HOUSING
				855.63	GROUND 5.0 FT. N. OF PROTECTIVE
5•	86°00'00.546"	4413647.287	585510.852	840.18	N. TOP OF PVC
				840.14	N. RIM OF PROTECTIVE HOUSING
				837.83	GROUND 4.0 FT. N. OF PROTECTIVE
3•	85°59'30.955"	4413042.842	586220.753	849.93	N. TOP OF PVC
				850.25	N. RIM OF PROTECTIVE HOUSING
				847.81	GROUND 5.0 FT. N. OF PROTECTIVE

	859.41	N. RIM OF PROTECTIVE HOUSING
	857.25	GROUND 4.0 FT. SOUTH OF PROTECTIVE HOUSING
4.929	861.54	N. TOP OF PVC
	861.69	N. RIM OF PROTECTIVE HOUSING
	859.31	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
1.765	861.16	N. TOP OF PVC
	861.35	N. RIM OF PROTECTIVE HOUSING
	858.79	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
7.973	858.58	N. TOP OF PVC
	858.89	N. RIM OF FLUSH MOUNT PROTECTIVE HOUSING
	858.79	GROUND 1.0 FT. N. OF PROTECTIVE HOUSING
3.339	867.63	N. TOP OF PVC
	867.89	N. RIM OF PROTECTIVE HOUSING
	865.37	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
8.447	865.92	N. TOP OF PVC
	866.10	N. RIM OF PROTECTIVE HOUSING
	863.65	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
1.819	866.61	N. TOP OF PVC
	866.88	N. RIM OF PROTECTIVE HOUSING
	864.41	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
5.701	867.54	N. TOP OF PVC
	867.81	N. RIM OF PROTECTIVE HOUSING
	865.28	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
8.074	754.51	N. TOP OF PVC
	754.79	N. RIM OF PROTECTIVE HOUSING
	752.00	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
6.918	869.94	N. TOP OF PVC
	869.96	N. RIM OF PROTECTIVE HOUSING
	867.68	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
8.920	869.33	N. TOP OF PVC
	869.17	N. RIM OF PROTECTIVE HOUSING
	867.22	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
6.096	865.20	N. TOP OF PVC
	865.36	N. RIM OF PROTECTIVE HOUSING
	862.86	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
0.588	863.31	N. TOP OF PVC
	863.23	N. RIM OF PROTECTIVE HOUSING
	861.39	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
7.783	857.84	N. TOP OF PVC
	857.65	N. RIM OF PROTECTIVE HOUSING
	855.63	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
0.852	840.18	N. TOP OF PVC
	840.14	N. RIM OF PROTECTIVE HOUSING
	837.83	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
0.753	849.93	N. TOP OF PVC
	850.25	N. RIM OF PROTECTIVE HOUSING
	847.81	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING

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BASELINES AND CONTROL POINTS

AREA	MSE NO.	NORTHING	EASTING	LATITUDE	
FBH25F	501	859811.903	405169.902	39°51'37.569"	8
FBH25F	502	859912.156	405166.200	39°51'38.560"	8
FBH25F	503	859939.730	404964.955	39°51'38.825"	8
FBH25F	504	859804.277	404969.960	39°51'37.486"	8
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FBH27	506	861108.329	404980.722	39°51'50.375"	8
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FBH29	508	856245.787	400999.479	39°51'02.166"	8
FBH29	509	856240.156	400998.279	39°51'02.111"	8
FBH29	510	856238.205	401010.420	39°51'02.092"	8
FBH17	511	861440.227	405503.377	39°51'53.674"	8
FBH17	512	861438.832	405655.595	39°51'53.666"	8
FBH17	513	861714.755	405713.914	39°51'56.395"	8
FBH17	514	861799.766	405514.602	39°51'57.228"	8
FBH17	515	861603.823	405353.857	39°51'55.286"	8
FBH8	516	858698.399	405575.284	39°51'26.580"	8
FBH8	517	858609.689	405078.078	39°51'25.684"	8
FBH8	518	858914.605	405071.099	39°51'28.698"	8
FBH8	519	858949.058	405570.494	39°51'29.057"	8
FBH11	520	863207.713	399391.937	39°52'10.907"	8
FBH11	521	862966.549	399378.882	39°52'08.523"	8
FBH11	522	863009.936	398944.063	39°52'08.935"	8
FBH11	523	863259.731	398850.896	39°52'11.400"	8
FBH11	524	863269.674	399093.178	39°52'11.508"	8
FBH26	525	861268.860	401624.434	39°51'51.833"	8
FBH26	526	861103.333	401512.771	39°51'50.193"	8
FBH26	527	861280.881	401336.741	39°51'51.941"	8
FBH26	528	861371.390	401398.119	39°51'52.838"	8
FBH21	529	861865.381	402419.294	39°51'57.759"	8
FBH21	530	861979.074	402304.367	39°51'58.879"	8
FBH21	531	862328.303	402345.746	39°52'02.331"	8
FBH21	532	862074.775	402548.252	39°51'59.837"	8

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MW 25	39°51'55.439'
LRC1	39°51'26.425'
LRC2	39°51'26.303'
LRC3	39°51'27.400'
LRC4	39°51'27.674'

NTS

LATITUDE	LONGITUDE	COMMENT
39°51'37.569'	86°00'16.070'	0·00N 2·00E PAINTED ON ASPHALT
39°51'38.560'	86°00'16.122'	1·00N 2·00E PAINTED ON ASPHALT
39°51'38.825'	86°00'18.704'	NW COR. TRASH AREA, PARK LOT ANGLE
39°51'37.486'	86°00'18.634'	0·00N 0·00E PAINTED ON ASPHALT
39°51'49.189'	86°00'18.476'	E. FACE POWER POLE
39°51'50.375'	86°00'18.559'	E. FACE POWER POLE
39°51'02.146'	86°01'09.221'	NE (2 X 2 W. HUB)
39°51'02.166'	86°01'09.369'	NW (2 X 2 W. HUB)
39°51'02.111'	86°01'09.384'	SW (2 X 2 W. HUB)
39°51'02.092'	86°01'09.228'	SE (2 X 2 W. HUB)
39°51'53.674'	86°00'11.872'	PINK FLAG
39°51'53.666'	86°00'09.920'	PINK FLAG
39°51'56.395'	86°00'09.186'	2 X 2 W. HUB
39°51'57.228'	86°00'11.746'	2 X 2 W. HUB
39°51'55.286'	86°00'13.798'	1·00N 0·40E (2 X 2 W. HUB)
39°51'26.580'	86°00'10.818'	2 X 2 W. HUB
39°51'25.684'	86°00'17.189'	2 X 2 W. HUB
39°51'28.698'	86°00'17.293'	2 X 2 W. HUB
39°51'29.057'	86°00'10.891'	2 X 2 W. HUB
39°52'10.907'	86°01'30.338'	NE FENCE COR.
39°52'08.523'	86°01'30.493'	0·40N 5·60E (2 X 2 W. HUB)
39°52'08.935'	86°01'36.072'	0·40N 0·80E (2 X 2 W. HUB)
39°52'11.400'	86°01'37.280'	2·80N 0·00E (2 X 2 W. HUB)
39°52'11.508'	86°01'34.173'	NW FENCE COR.
39°51'51.833'	86°01'01.608'	2·40N 2·40E (2 X 2 W. HUB)
39°51'50.193'	86°01'03.032'	ORANGE FLAG
39°51'51.941'	86°01'05.298'	SW COR. CONC. WALL, OUTSIDE COR.
39°51'52.838'	86°01'04.516'	NW COR. CONC. WALL, OUTSIDE COR.
39°51'57.759'	86°00'51.444'	ORANGE FLAG
39°51'58.879'	86°00'52.924'	YELLOW FLAG
39°52'02.331'	86°00'52.411'	ORANGE FLAG
39°51'59.837'	86°00'49.801'	2 X 2 W. HUB

B | C | D

14

39°51′55.439″	85°59′53.467″	4413088.498	585685.307	843.56	TOP OF PVC. WELL IN C
				843.69	N. RIM OF PROTECTIVE
				842.19	GROUND 1.0 FT. N. OF
39°51′26.425″	86°00′16.395″	4412187.905	585150.532	865.28	GROUND. ABANDONED LOC
39°51′26.303″	86°00′14.103″	4412184.747	585205.029	865.23	GROUND. ABANDONED LOC
39°51′27.400″	86°00′16.173″	4412218.027	585155.456	864.24	GROUND. ABANDONED LOC
39°51′27.674″	86°00′13.132″	4412227.275	585227.638	863.52	GROUND. ABANDONED LOC

D E F

15

WELL IN GOOD COND.
IOTECTIVE HOUSING
'T. N. OF CASING
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SMBKGMW002	39°51'01.218"	86°00'40.392"	44
SMBKGMW003	39°51'08.684"	86°00'20.625"	44
SMBKGMW004	39°51'18.742"	86°00'01.353"	44
SMBKGMW005	39°51'32.009"	85°59'36.448"	441
SMBKGMW006	39°52'13.625"	86°00'00.546"	441
SMBKGMW007	39°51'53.763"	85°59'30.955"	441

REVISIONS AND DATES		
TABLES REVISED 4-19-94 GTJ	DESIGNED BY:	
	DRAWN BY: MDK	
	CHECKED BY: AHG	
	APPROVED BY: AHG	DATE: MARCH 18, 1994

4/21/94

ANDREW H. GERDOM
REGISTERED
No. 880031
STATE OF
INDIANA
LAND SURVEYOR

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G H I

16

		869.96	N. RIM OF PROTECTIVE HOUSING
		867.68	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
4411404.456	584588.920	869.33	N. TOP OF PVC
		869.17	N. RIM OF PROTECTIVE HOUSING
		867.22	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
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		865.36	N. RIM OF PROTECTIVE HOUSING
		862.86	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
4411955.029	585510.588	863.31	N. TOP OF PVC
		863.23	N. RIM OF PROTECTIVE HOUSING
		861.39	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
4412370.702	586097.783	857.84	N. TOP OF PVC
		857.65	N. RIM OF PROTECTIVE HOUSING
		855.63	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING
4413647.287	585510.852	840.18	N. TOP OF PVC
		840.14	N. RIM OF PROTECTIVE HOUSING
		837.83	GROUND 4.0 FT. N. OF PROTECTIVE HOUSING
4413042.842	586220.753	849.93	N. TOP OF PVC
		850.25	N. RIM OF PROTECTIVE HOUSING
		847.81	GROUND 5.0 FT. N. OF PROTECTIVE HOUSING

PREPARED FOR: HARDING LAWSON ASSOCIATES
AND U.S. ARMY ENVIRONMENTAL CENTER

SE Surveying
E CORPORATION
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DIANAPOLIS, IN 46204 1061
7 634-1000
7 634-3576 FAX

Plate 2

FORT BENJAMIN HARRISON
MONITORING WELL LOCATIONS
MARION COUNTY, INDIANA

SCALE: 1" = 800 JOB NO.: 121-2042 SHEET NO.: 2 OF 2

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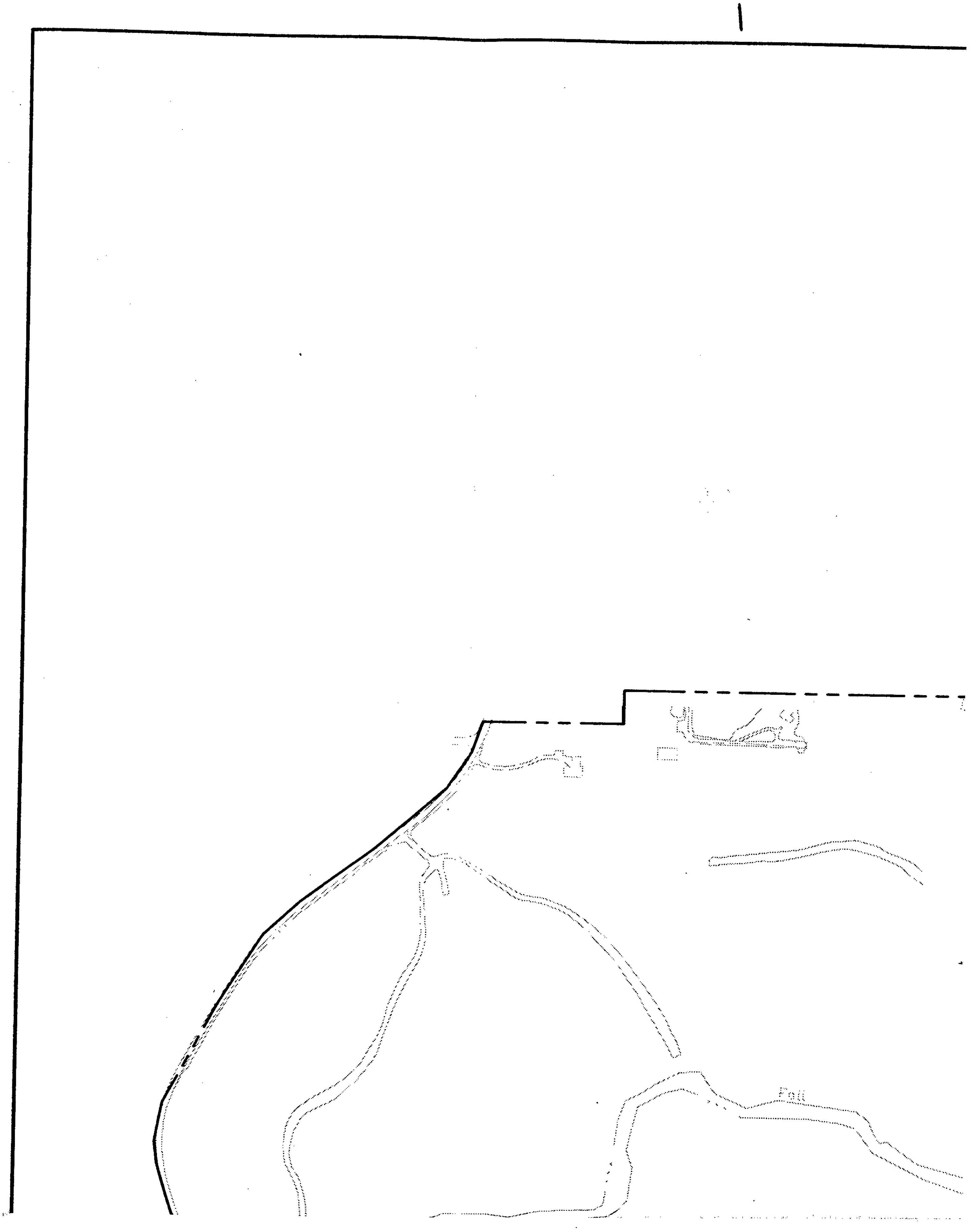
I J I K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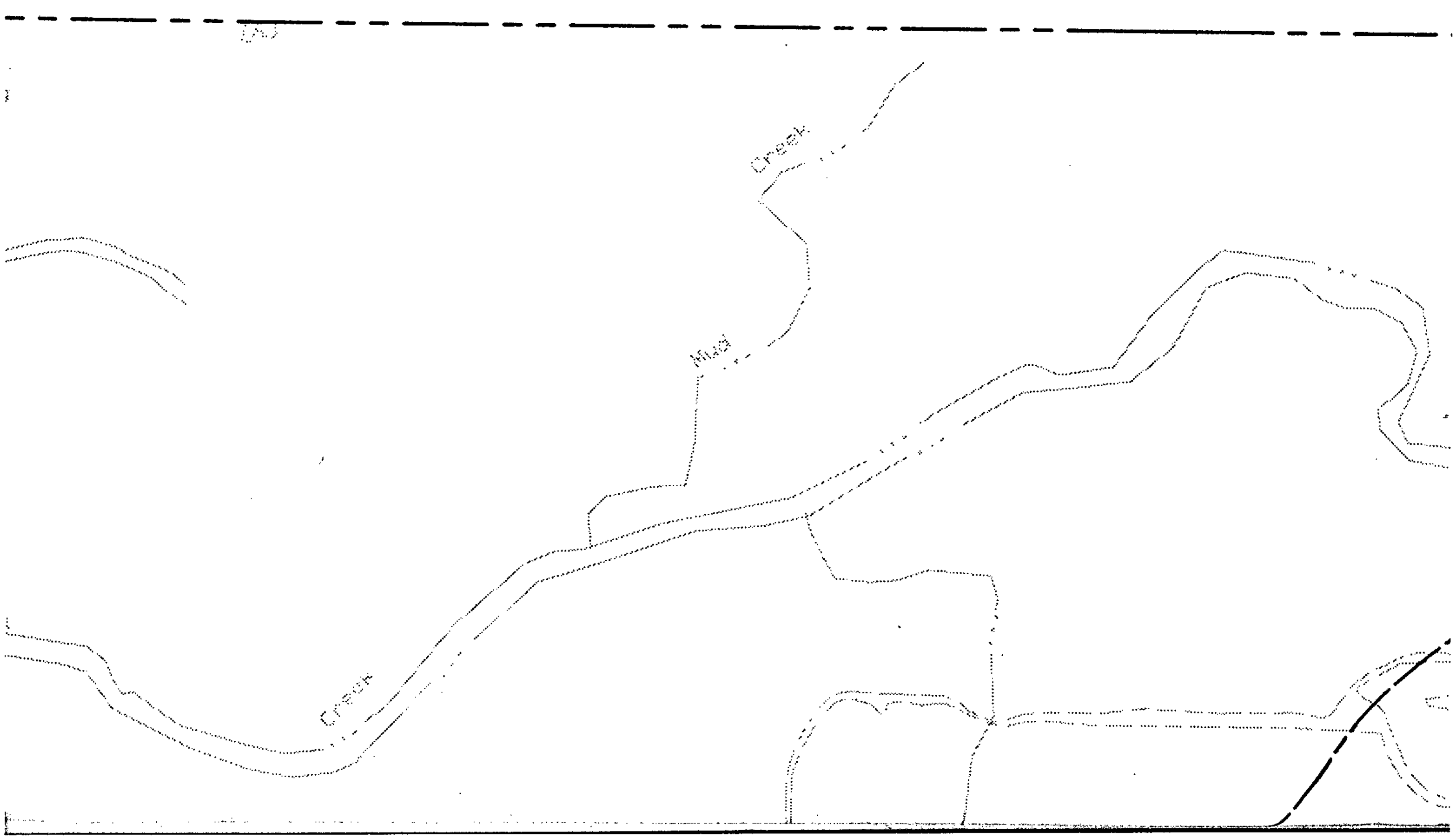

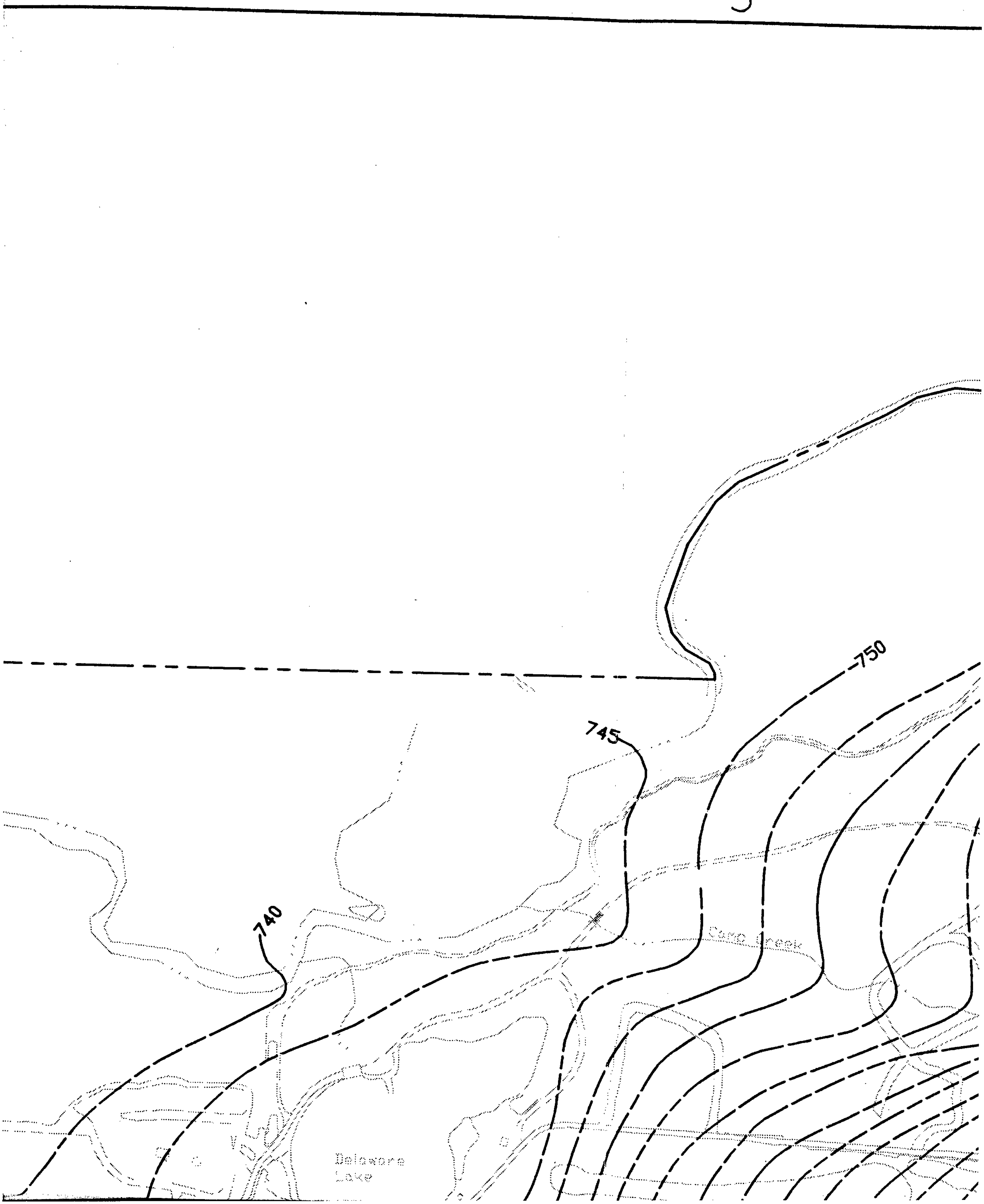
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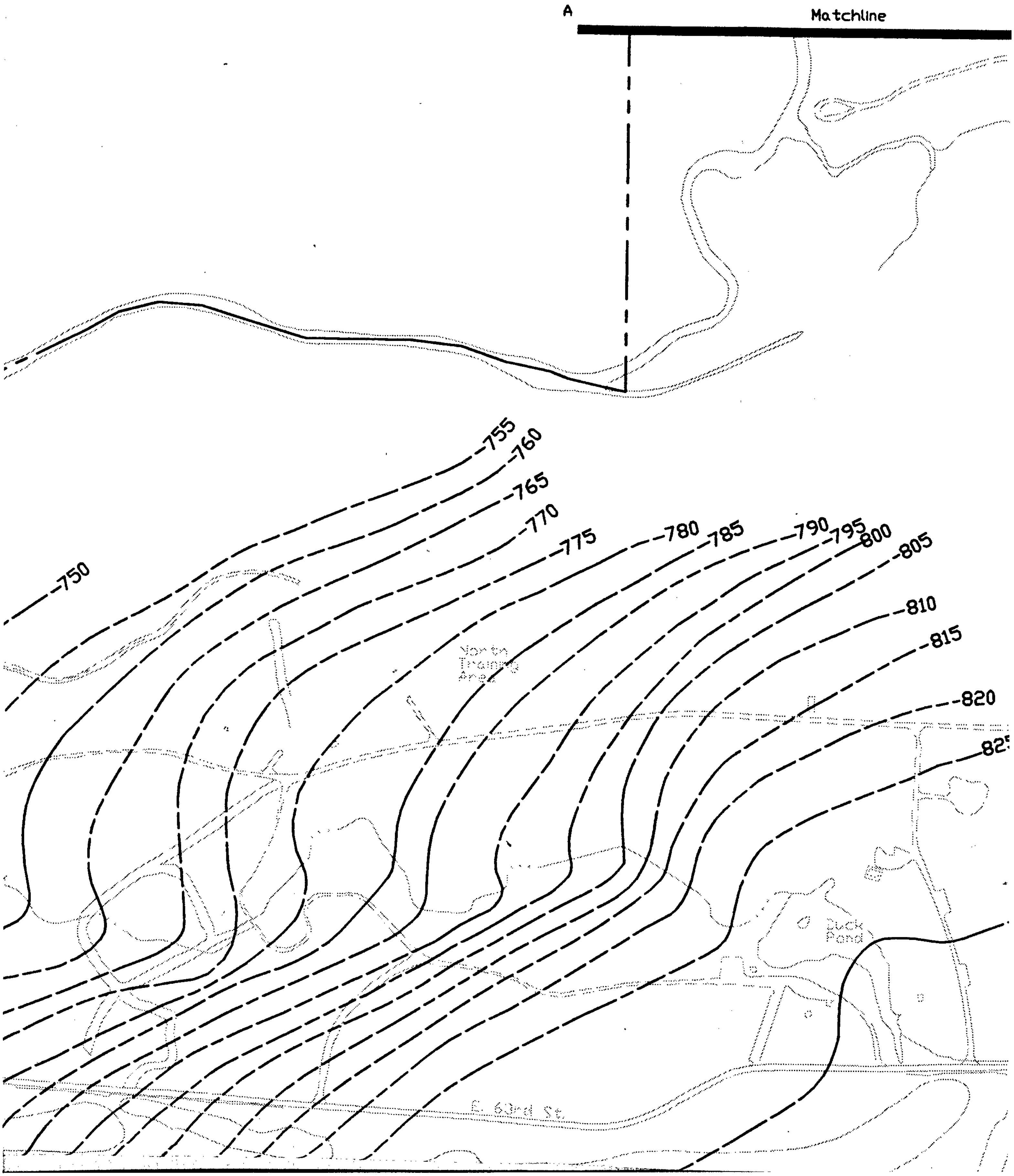
745
740
Camp Creek
Delaware
Lake

4



A
Matchline
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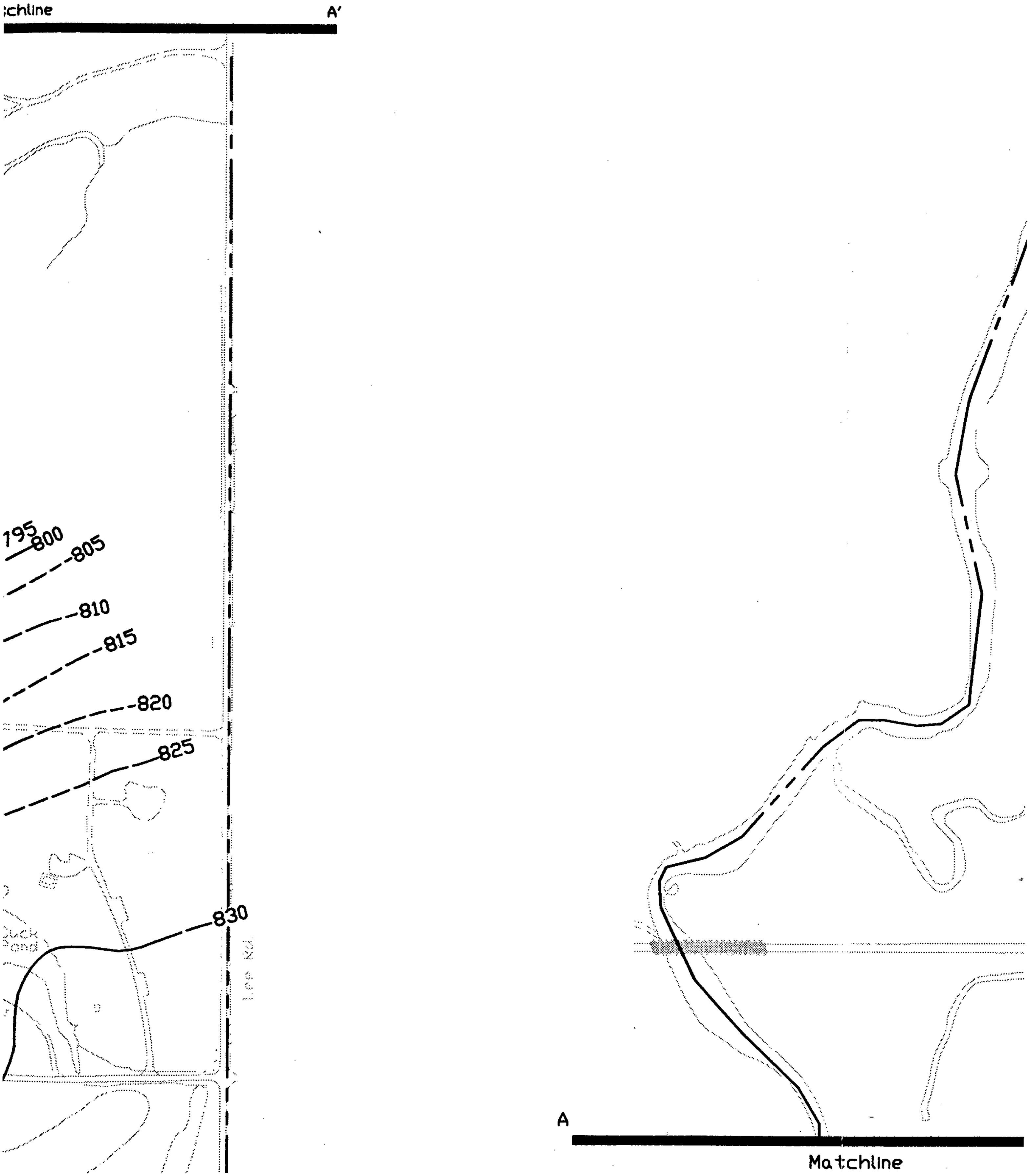
North Training Area
Duck Pond
E. 63rd St.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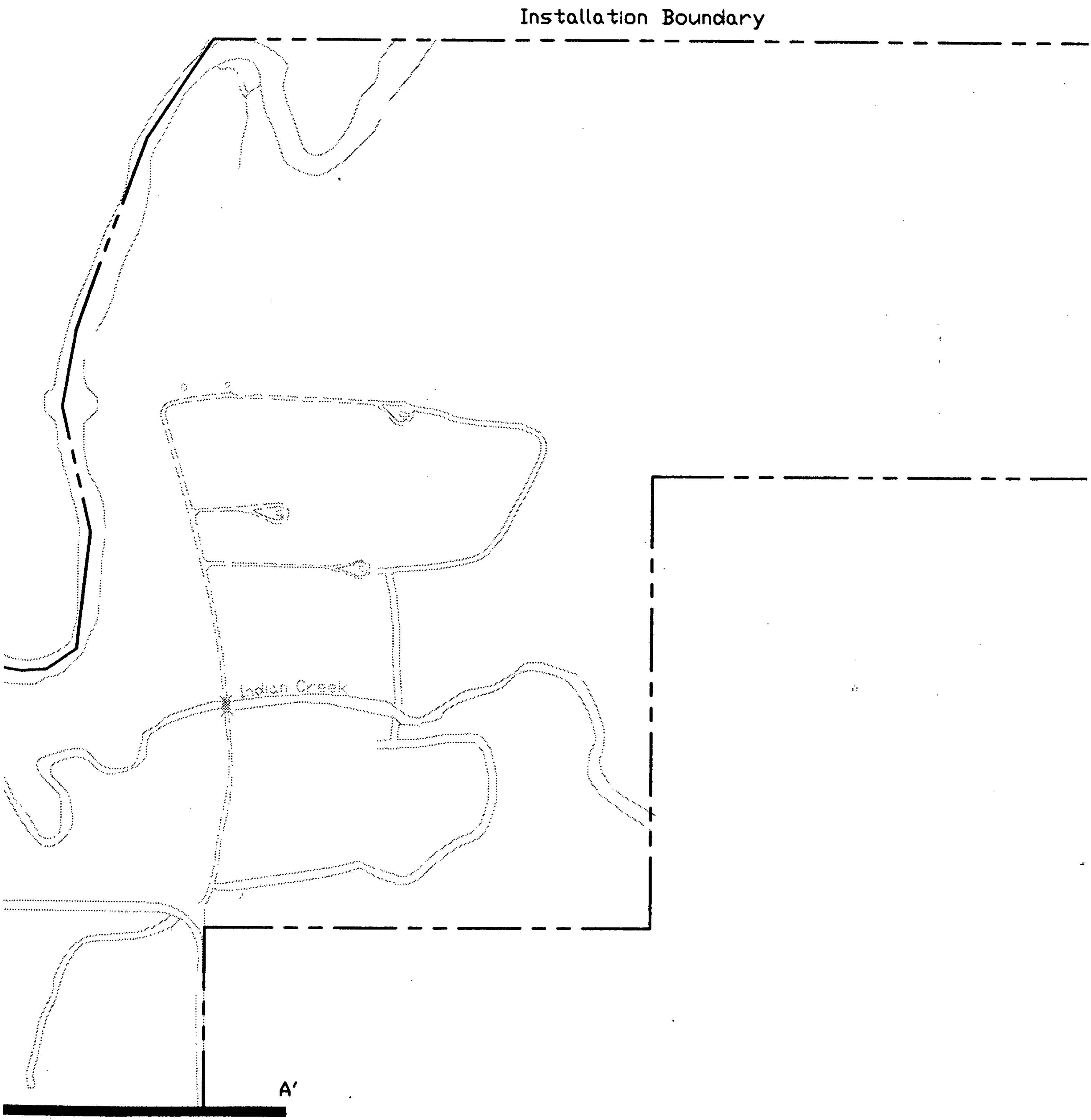
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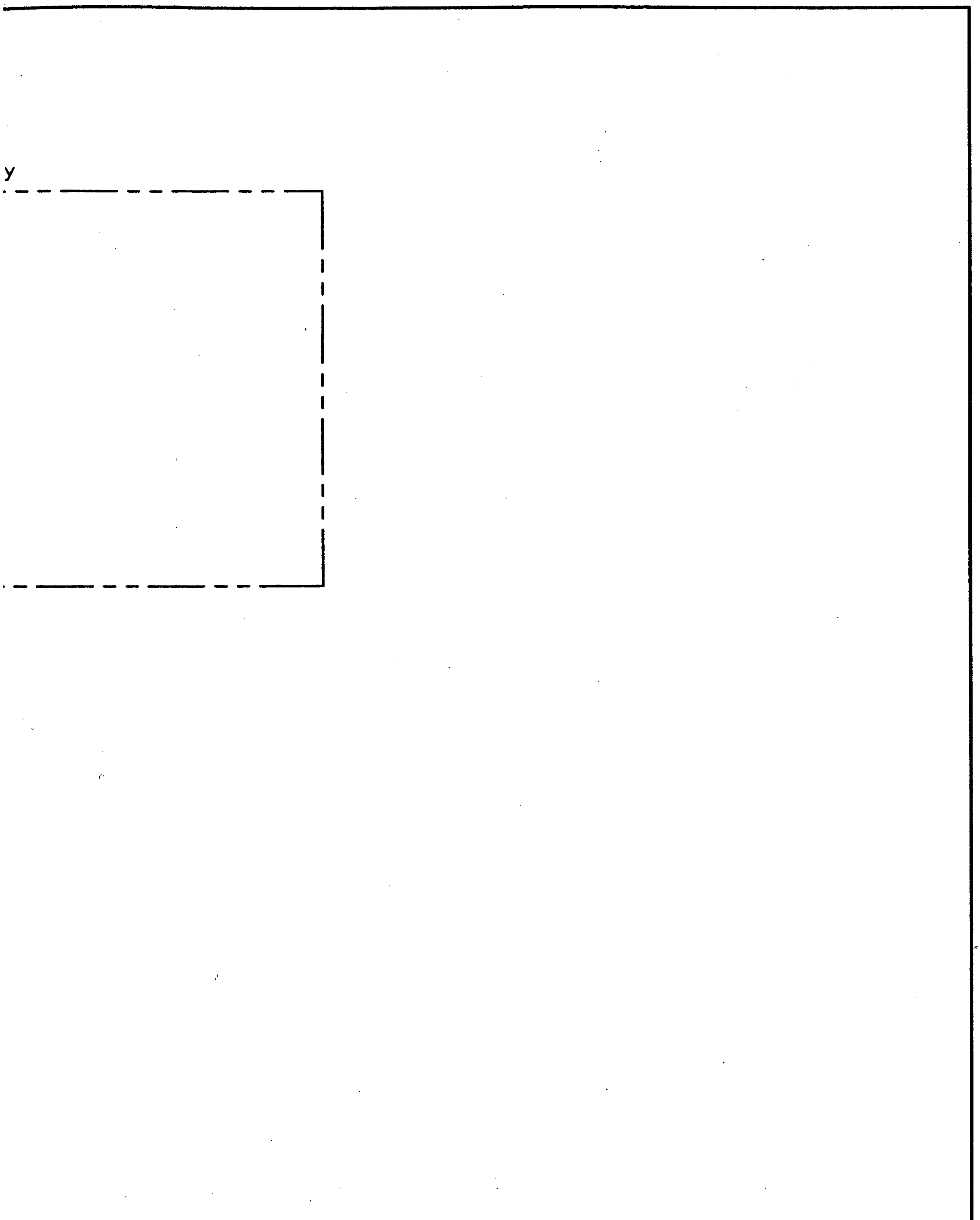
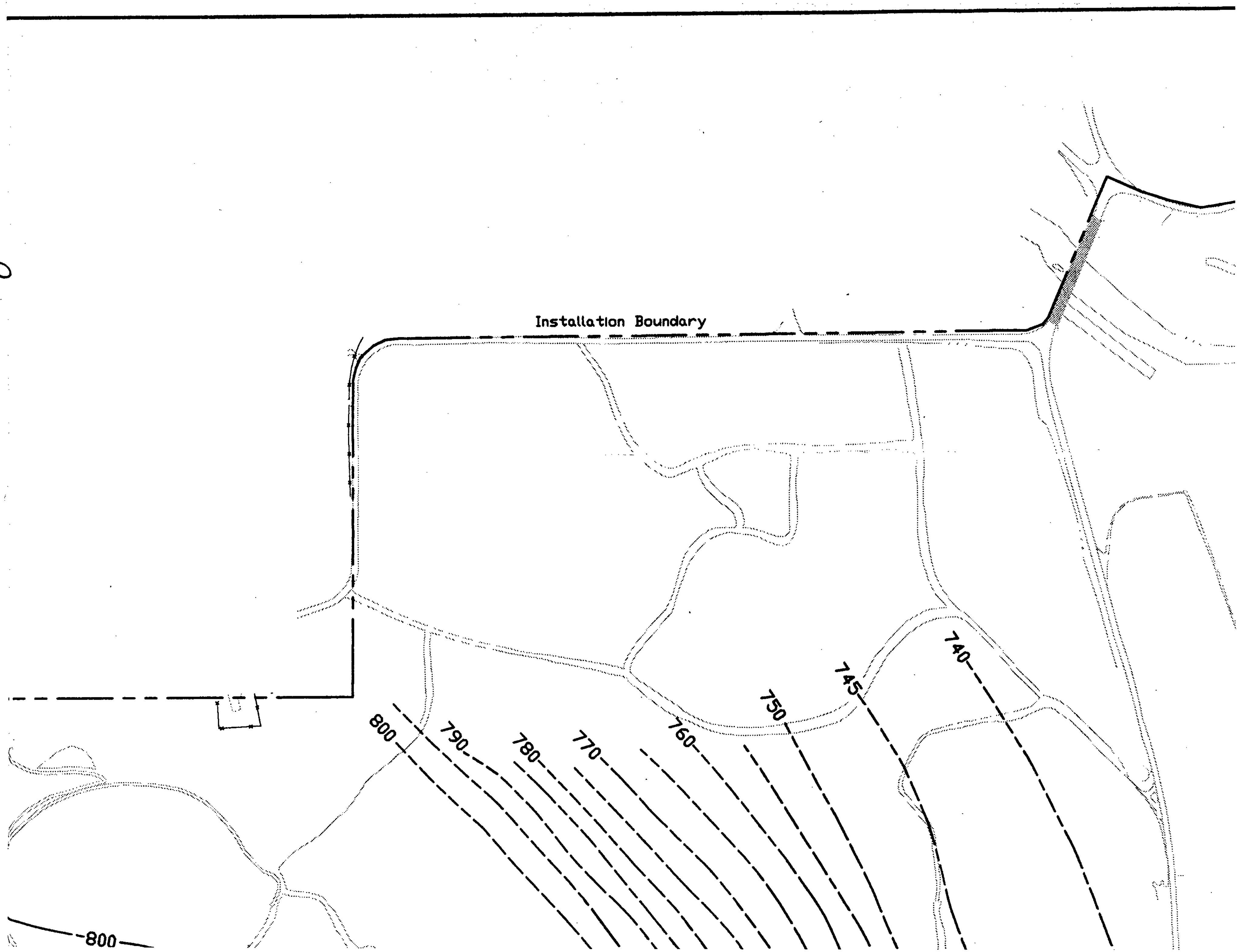
Indian Creek
A'

7




Installation Boundary
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790
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760
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745
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800

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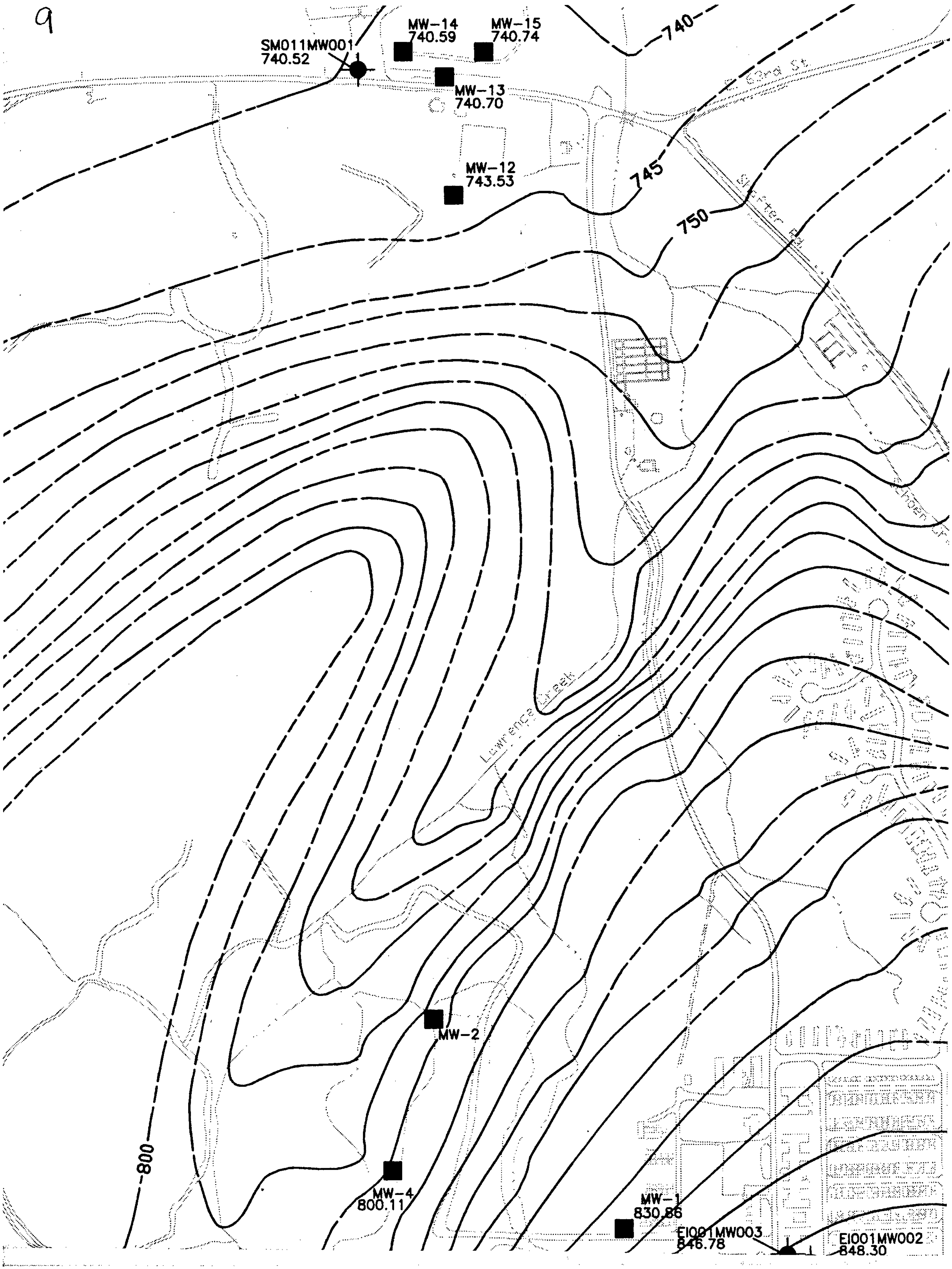
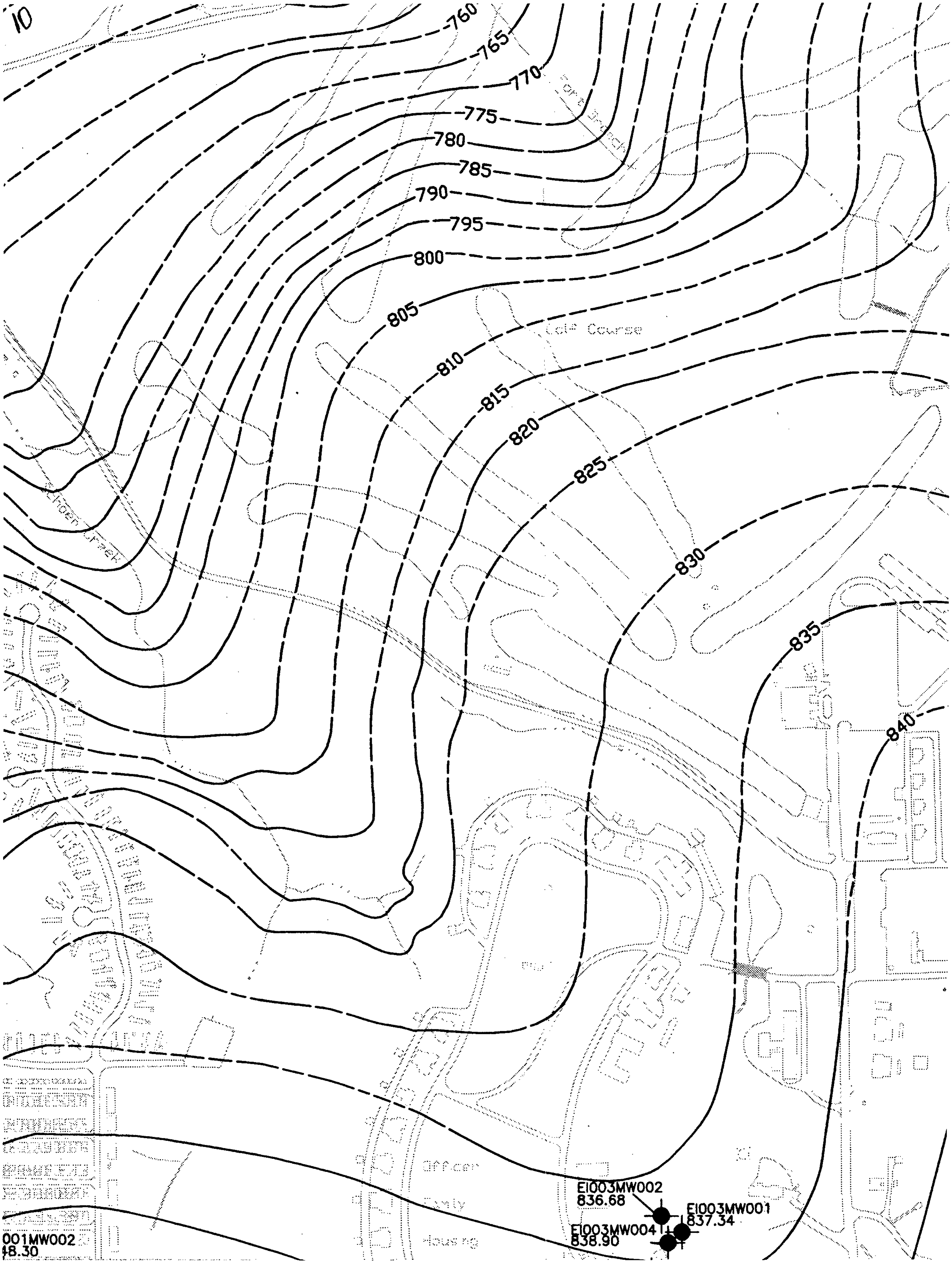
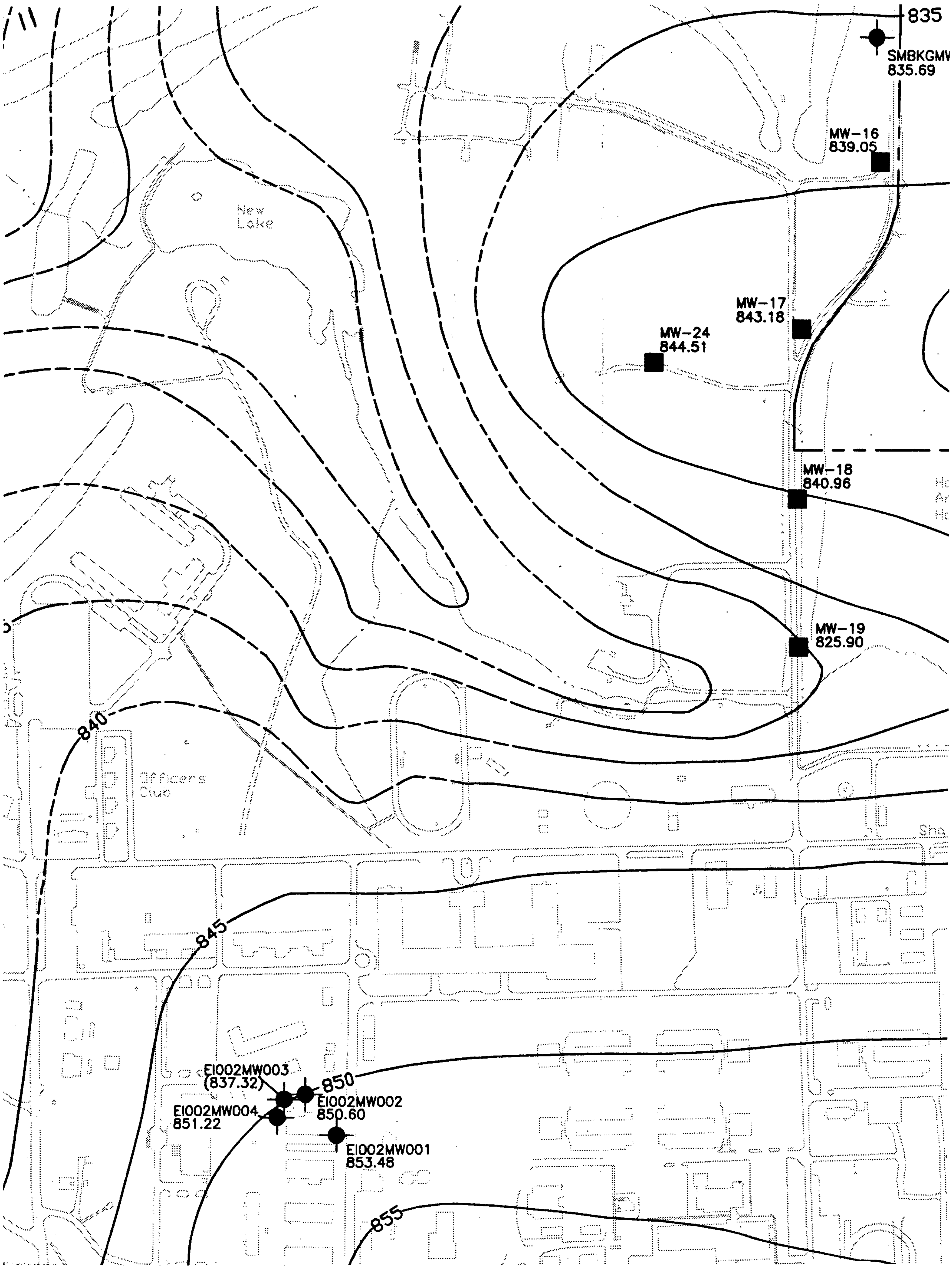

SM011MW001
740.52
MW-14
740.59
MW-15
740.74
MW-13
740.70
740
63rd St
MW-12
743.53
745
750
Lawrence Creek
MW-2
800
MW-4
800.11
MW-1
830.86
EI001MW003
846.78
EI001MW002
848.30

10



760
765
770
775
780
785
790
795
800
805
810
815
820
825
830
835
840
Golf Course
Schoen Creek
Fort Branch
Officer
Family
Housing
EI003MW002
836.68
EI003MW001
837.34
EI003MW004
838.90
001MW002
48.30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SMBKGMW
835.69
MW-16
839.05
New
Lake
MW-17
843.18
MW-24
844.51
MW-18
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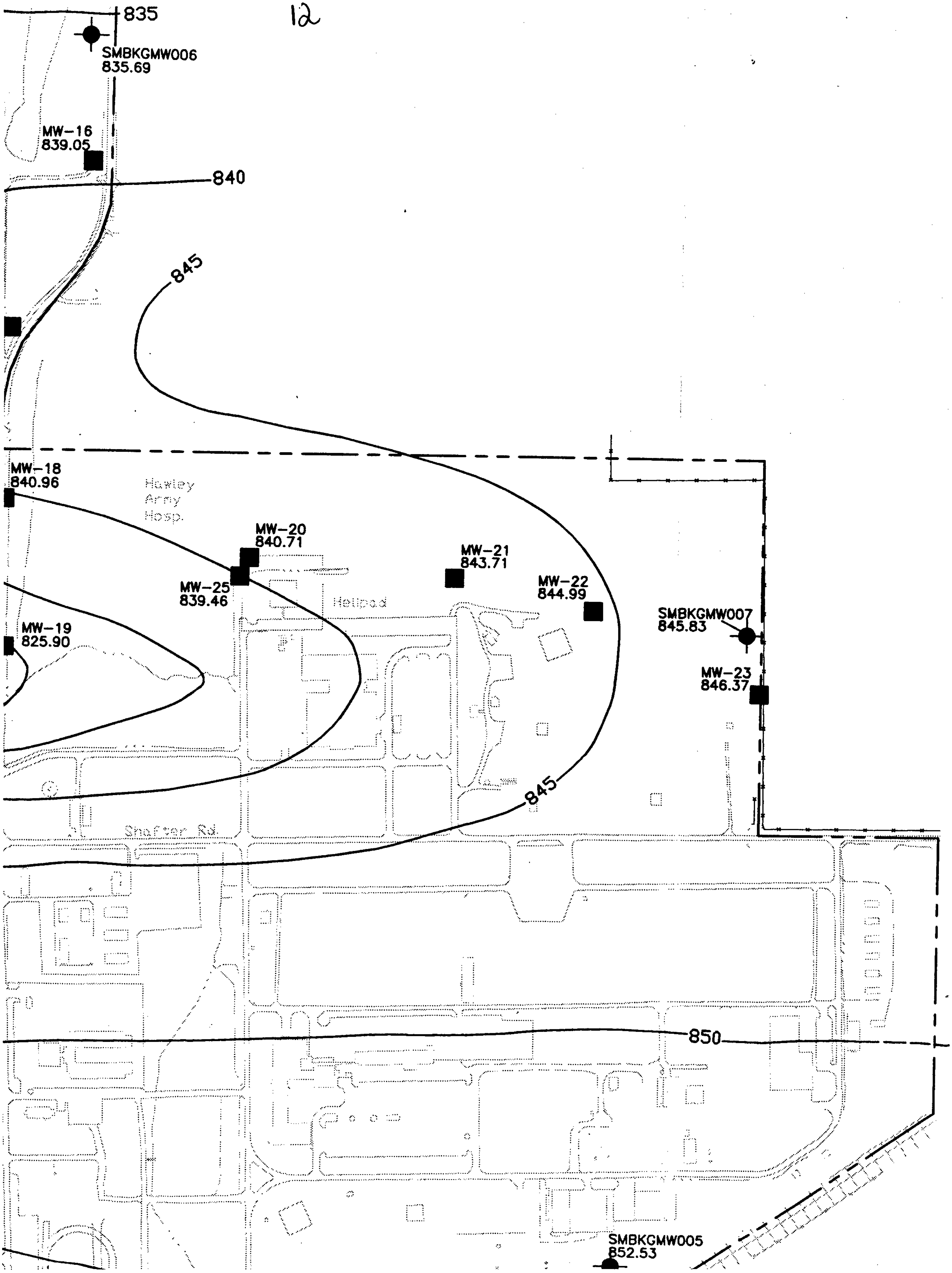
MW-19
825.90
840
Officers
Club
845
EI002MW003
(837.32)
850
EI002MW002
850.60
EI002MW004
851.22
EI002MW001
853.48
855

12



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SMBKGMW006
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MW-16
839.05
840
845
MW-18
840.96
Hawley
Army
Hosp.
MW-20
840.71
MW-21
843.71
MW-25
839.46
Helipad
MW-22
844.99
SMBKGMW007
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MW-19
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MW-23
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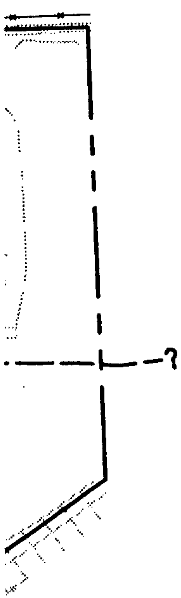
845
Shafter Rd.
850
SMBKGMW005
852.53

13



Previously ex

Monitoring w

(861.38) Water level

Water–level
(5 foot con

14

Explanation

Previously existing monitoring well (by others)

Monitoring well installed by Harding Lawson Associates

(861.38) Water level elevation not used in contouring

Water–level elevation contour line, dashed where infered (5 foot contour interval)

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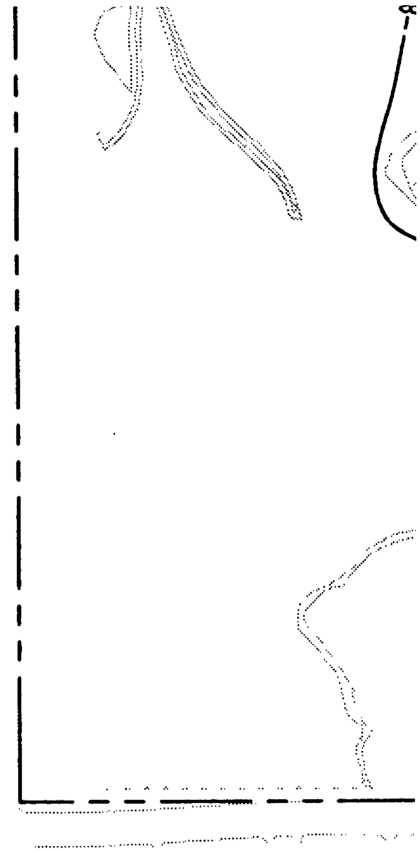

FBH/21574503 9/6/95 LDZ

Harding Lawson Associates

Engineering and
Environmental Services

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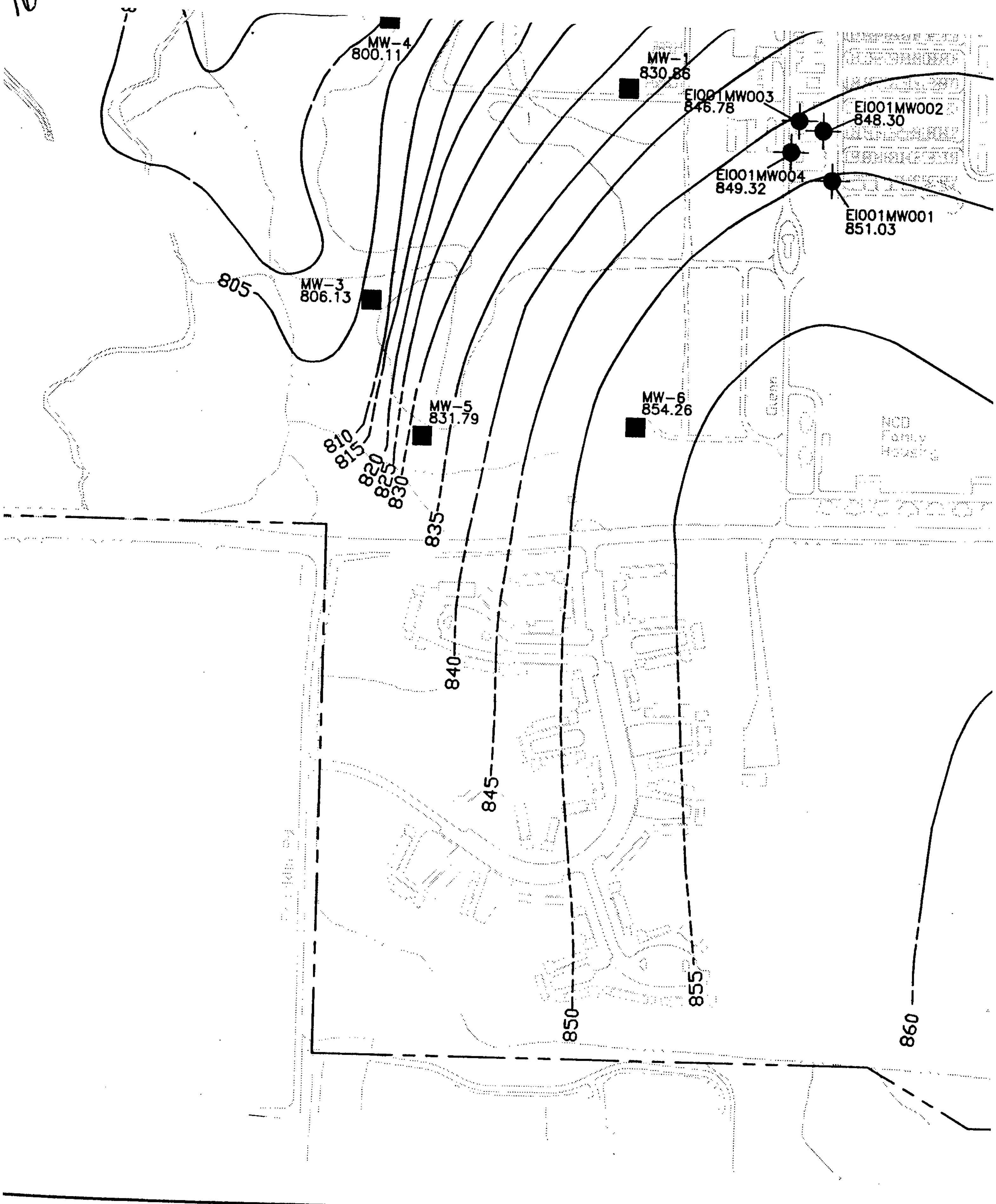
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EI001MW002
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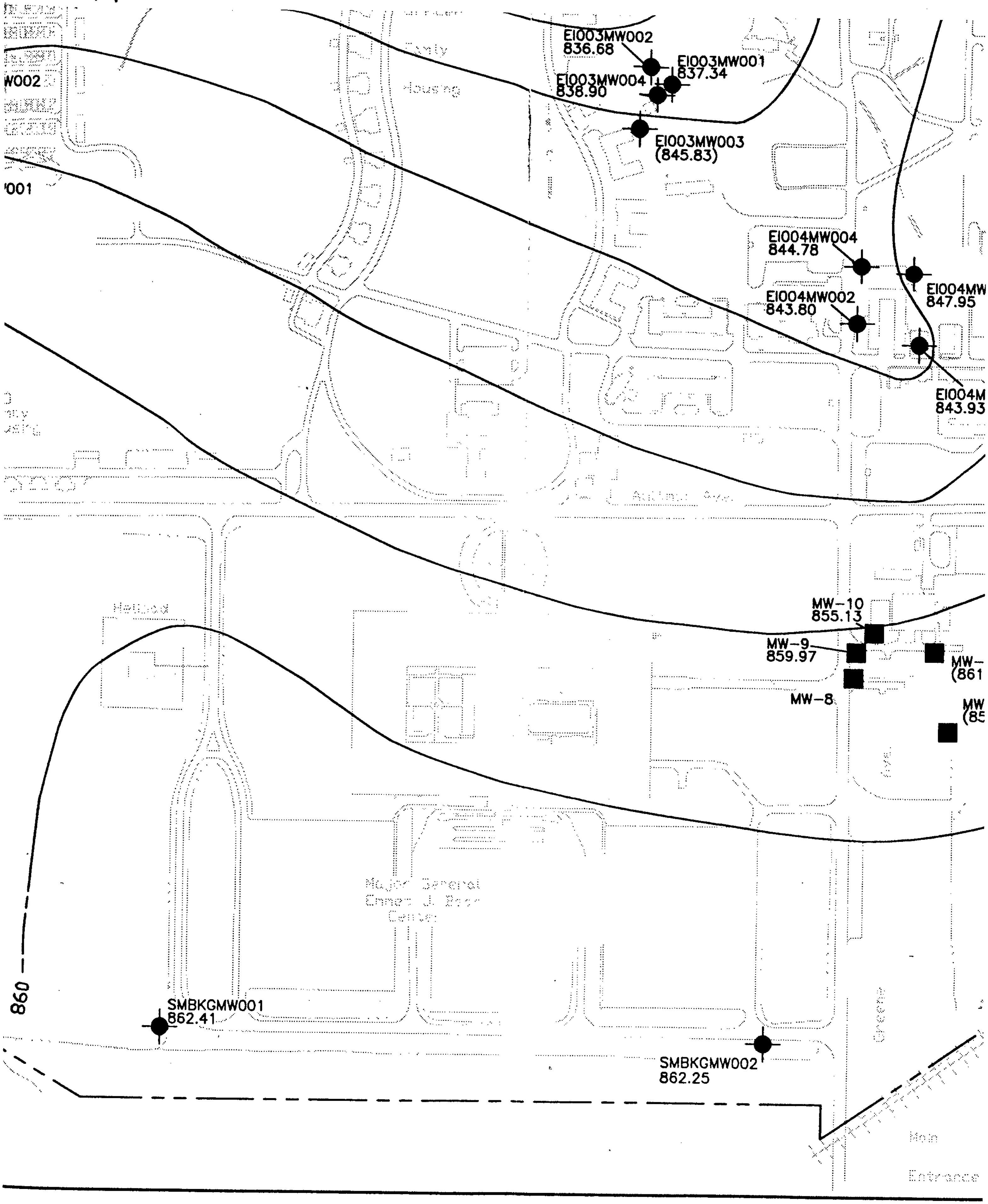
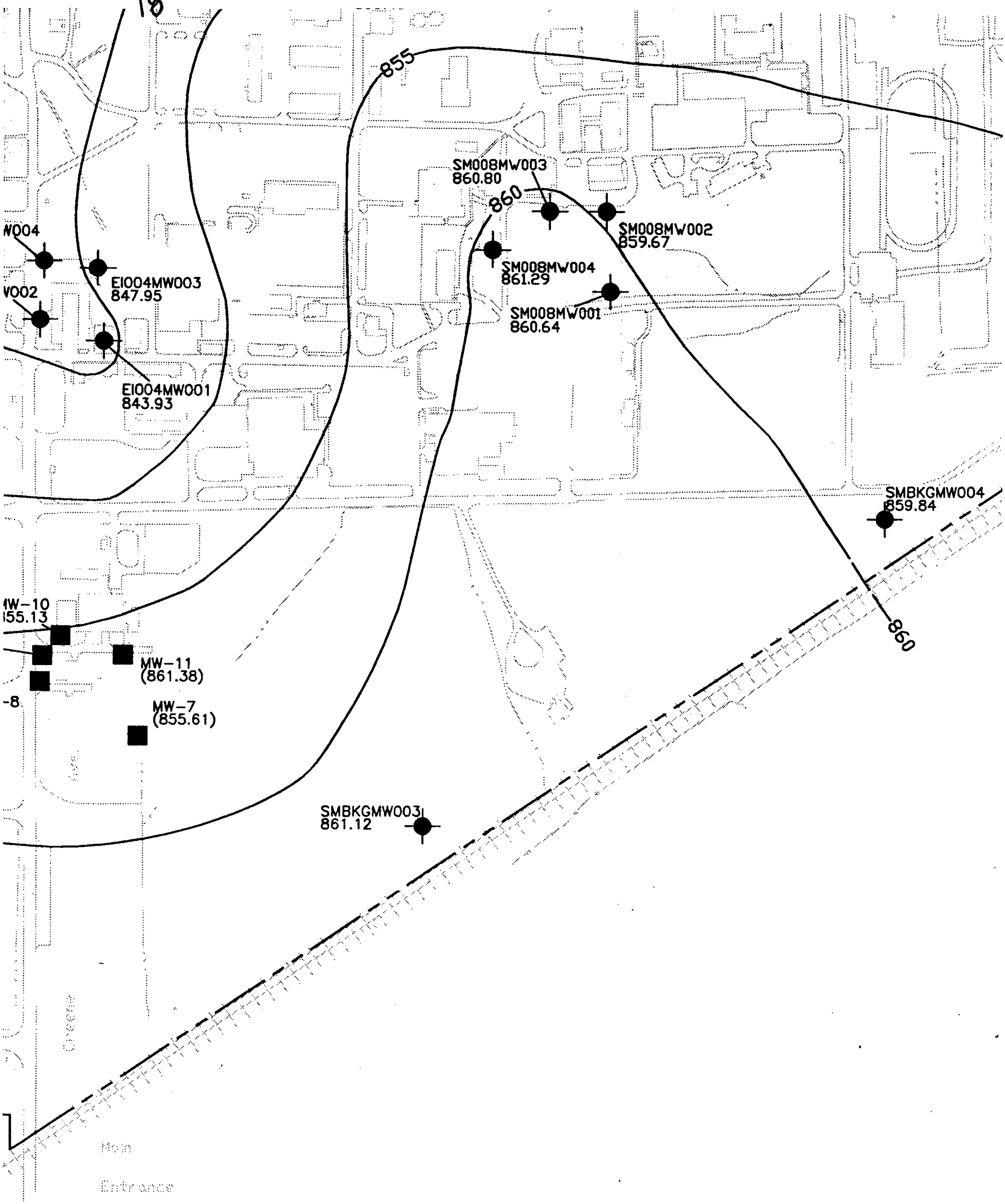
EI001MW004
849.32
EI001MW001
851.03
MW-3
806.13
805
MW-5
831.79
MW-6
854.26
NCD
Family
Housing
810
815
820
825
830
835
840
845
850
855
860

17



EI003MW002
836.68
EI003MW001
837.34
EI003MW004
838.90
EI003MW003
(845.83)
Family
Housing
W002
'001
EI004MW004
844.78
EI004MW
847.95
EI004MW002
843.80
EI004M
843.93
Austin Ave.
MW-10
855.13
MW-9
859.97
MW-
(861
MW-8
MW
(85
Helipad
Major General
Emmet J. Bean
Center
860
SMBKGMW001
862.41
SMBKGMW002
862.25
Greene
Main
Entrance



18
855
860
SM008MW003
860.80
SM008MW002
859.67
SM008MW004
861.29
SM008MW001
860.64
W004
EI004MW003
847.95
W002
EI004MW001
843.93
SMBKGMW004
859.84
W-10
55.13
MW-11
(861.38)
-8
MW-7
(855.61)
SMBKGMW003
861.12
Main
Entrance

19

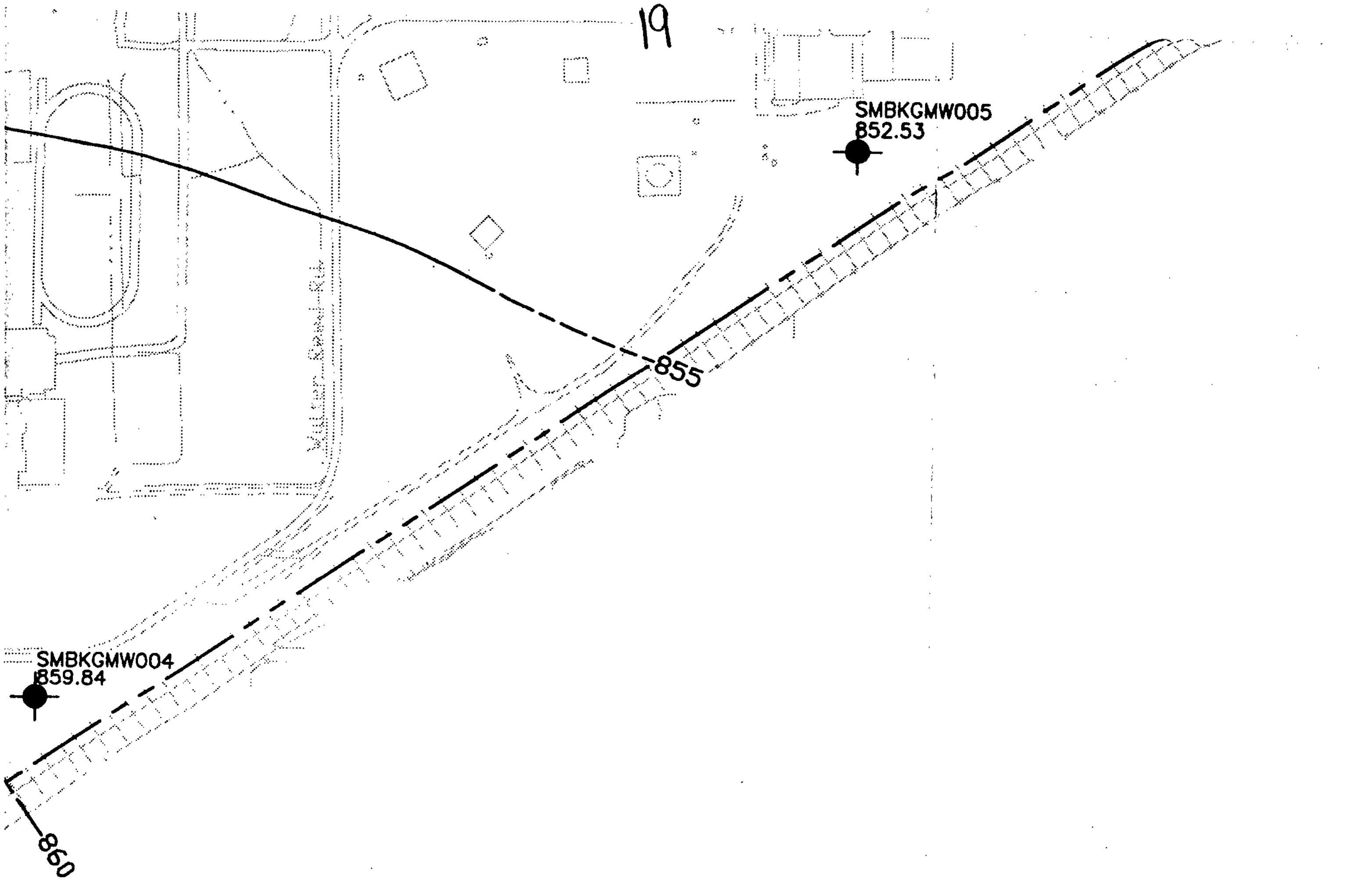


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Plate 1

Water–Level
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February 14

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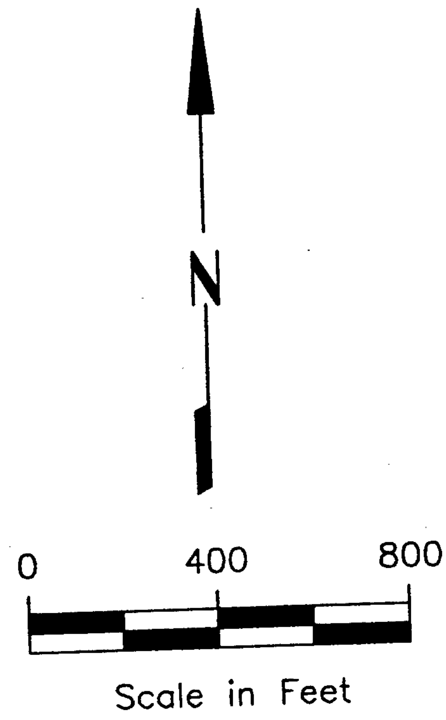

Prepared for:

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Fort Benjamin Harrison
Marion County, Indiana

Plate 1

Water-Level Contour Map
(Water Levels Measured
February 14, 1994)

Appendix A

SOIL-GAS SURVEY RESULTS

Vapor Trace® Soil Gas Investigation

FT. BENJAMIN HARRISON
Indianapolis, Indiana

September 16 through October 1, 1993

Tracer Research Corporation

Tracer Research Corporation

Vapor Trace® Soil Gas
Investigation

FT. BENJAMIN HARRISON
Indianapolis, Indiana

September 16 through
October 1, 1993

Tracer Research Corporation

Vapor Trace® Soil Gas Investigation

FT. BENJAMIN HARRISON
Indianapolis, Indiana

September 16 through October 1, 1993

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Submitted by:

Karen L. McWhirter

Marjorie D. Stivers

2-93-295-S

TABLE OF CONTENTS

TABLES

1.0 FT. BENJAMIN HARRISON INVESTIGATION

Tracer Research Corporation (Tracer Research) performed a *Vapor Trace*® soil gas investigation at Ft. Benjamin Harrison in Indianapolis, Indiana. The investigation was conducted September 16 through October 1, 1993 for Harding Lawson Associates (HLA) of Denver, Colorado.

1.1 Objective

The purpose of the investigation was to identify the presence of hazardous waste or hazardous constituents at the RCRA Facility Investigation (RFI) Sites and Environmental Investigation (EI) Sites and to evaluate which sites may require additional site characterization during Phase II field investigations. The soil gas samples were collected and analyzed for the following analyte classes and compounds:

Analyte Class: Hydrocarbon
benzene, toluene, ethylbenzene, xylenes (BTEX)
total volatile hydrocarbons (TVHC C_4-C_{12})

Analyte Class: Halocarbon
vinyl chloride
methylene chloride (CH_2Cl_2)
1,1 dichloroethane (1,1 DCA)
total 1,2 dichloroethene (total 1,2 DCE)
chloroform ($CHCl_3$)
1,2 dichloroethane (1,2 DCA)
1,1,1 trichloroethane (TCA)
trichloroethene (TCE)
tetrachloroethene (PCE)

1.2 Overview of Results

For this investigation, fifty-three samples were collected from fifty-three sampling locations. Two collocated samples were collected and analyzed at locations SG-32 in Area E26 and SG-17 in Area E03. Samples were collected at depths of 3 to 6 feet below ground surface (bgs).

Hydrocarbons were detected at low concentrations at 19 sampling locations. The highest concentration was 4,700 µg/L at SG-14-4' in Area E26. Halocarbon compounds were included in the hydrocarbon concentration when these compounds were detected on both detectors. These TVHC concentrations are noted with an asterisk "*" in Appendix A.

The highest concentrations of halocarbons, TCE (91 µg/L) and PCE (13 µg/L), were detected in Area E26. Concentrations of TCA near detection limits were detected throughout the areas.

2.0 SITE DESCRIPTION

The soil gas samples were collected at seven areas within Ft. Benjamin Harrison. Areas labeled with an "E" are EI sites; areas labeled with an "S" are RFI sites. Area E01 is around the Auto Craft Shop while Area E02 is around the Roads and Grounds Vehicle Maintenance Shop. Area E03 is a former PX Gas Station that was closed in 1992 when five underground storage tanks were removed. The area is now a parking lot for vehicle maintenance. Area E26 encompasses the Director of Installations and Support Engineering and Maintenance Building #26. Area S08 was a former drum storage area that is now a grass field. No soil gas samples could be collected in this area due to subsurface conditions. Area S25C, which was a military dump in World War I, is located on a golf course. Area S25F is also a historic military site. It was a World War II military dump that is currently a parking lot.

The subsurface of the site was reported to consist of glacial clay till. The depth to groundwater was 10 to 15 feet bgs, however, water was encountered at shallower depths.

3.0 SOIL GAS SAMPLING PARAMETERS

Soil gas sampling probes consisted of 7-foot lengths of 3/4-inch diameter hollow stainless steel pipe. The probes were fitted with detachable drive tips and hydraulically pushed and/or pounded to depths of 3 to 6 feet bgs. Where there was not van access, the probes were hand pounded to depth. An electric rotary hammer drill was used to drill holes through the asphalt. Soil gas samples could not be collected from sampling locations where shallow water or maximum vacuum were encountered.

The aboveground end of each probe was fitted with an aluminum reducer (manifold) and a length of polyethylene tubing leading to a vacuum pump. Soil gas was pulled by the vacuum pump into the probe. The volume of air within the probe was purged by evacuating 2 to 5 probe volumes of soil gas. The evacuation time in minutes versus the vacuum in inches of mercury (Hg) was used to calculate the necessary evacuation time. The vacuum in inches Hg was recorded at each sampling location. After the probe was

evacuated, the vacuum was removed and the pressure within the sampling system returned to atmospheric pressure. A soil gas sample was collected in a syringe by inserting a syringe needle through a silicone rubber segment in the evacuation line and down into the steel probe.

Sample probe vacuums ranged from 2 to 19 inches Hg. The vacuum capacity of the pump was approximately 22 inches Hg.

4.0 ANALYTICAL PARAMETERS

During this investigation, up to 10 milliliters (mL) of soil gas were collected for each sample and immediately analyzed in the Tracer Research analytical van. Subsamples (replicates) from these samples were injected into the gas chromatograph (GC) in volumes of 1 to 500 microliters (µL).

The analytical instruments were calibrated at the beginning of the investigation by performing a three point calibration using fresh working standards made from National Institute of Sciences and Technology (NIST) traceable standards and reagent blanked solvents.

4.1 Chromatographic System

A Hewlett Packard 5890 Series II gas chromatograph, equipped with a flame ionization detector (FID), an electron capture detector (ECD), and two computing integrators, was used for the soil gas analyses. The compounds were separated in the GC on two 6-foot by 1/8 inch outer diameter (OD) packed analytical columns (1% SP1000 stationary phase bonded to 60/80 mesh Carbopack B support) in a temperature controlled oven. Vinyl chloride and the hydrocarbons were detected on the FID and the remaining halocarbons were detected on the ECD. Nitrogen was used as the carrier gas.

The instrument calibrations were checked periodically throughout the day to monitor the response factors and retention times. The following paragraphs explain the GC, FID, and ECD processes.

GC Process

The soil gas is injected into the GC where it is swept through the analytical column by the carrier gas. The detector senses the presence of a component different from the carrier gas and converts that information to an electrical signal. The components of the sample pass through the column at different rates, according to their individual properties, and are detected by the detector. Compounds are identified by the time it takes them to pass through the column (retention time).

FID Process

The FID utilizes a flame produced by the combustion of hydrogen and air. When a component, which has been separated on the GC analytical column, is introduced into the flame, a large increase in ions occurs. A collector with a polarizing voltage is applied near the flame and the ions are attracted and produce a current, which is proportional to the amount of the sample compound in the flame. The electrical current causes the computing integrator to record a peak on a chromatogram. By measuring the area of the peak and comparing that area to the integrator response of a known aqueous standard, the concentration of the analyte in the sample is determined.

ECD Process

The ECD captures low energy thermal electrons that have been ionized by beta particles. The flow of these captured electrons into an electrode produces a small current, which is collected and measured. When the halogen atoms (halocarbons) are introduced into the detector, electrons that would otherwise be collected at the electrode are captured by the sample, resulting in decreased current. The current causes the computing integrator to record a peak on a chromatogram. The area of the peak is compared to the peak generated by a known standard to determine the concentration of the analyte.

4.2 Analyses

The detection limits for target compounds depend on the sensitivity of the detector to the individual compound as well as the volume of the sample injection. The detection limits of the target compounds were calculated from the response factor, the sample injection size, and the calculated minimum peak size (area) observed under the conditions of

the analyses. If any compound was not detected in an analysis, the detection limit is given as a "less than" value, e.g., <0.01 µg/L. The approximate detection limits for the target compounds are presented in Table 1.

Table 1. Detection Limits for Target Compounds

Compound	Detection Limits (µg/L)
vinyl chloride	0.3
benzene	0.4
toluene	0.3
ethylbenzene	0.7
xylenes	1
TVHC C_4-C_{12}	1
CH_2Cl_2	0.04
1,1 DCA	0.3
total 1,2 DCE	0.1
$CHCl_3$	0.002
1,2 DCA	0.09
TCA	0.001
TCE	0.006
PCE	0.004

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

Tracer Research's Quality Assurance (QA) and Quality Control (QC) program was followed to maintain data that was reproducible through the investigation. An overview presenting the significant aspects of this program is presented on the following pages.

Soil Gas Sampling Quality Assurance

To ensure consistent collection of samples, the following procedures are performed:

- Sampling Manifolds

Tracer Research's custom designed sampling manifold connects the sample probe to the vacuum line and pump. The manifold is designed to eliminate sample exposure to the polymeric (plastic) materials that connect the probe to the vacuum pump.

The sampling manifold is attached to the end of the probe, forming an air tight union between the probe and the silicone tubing septum. The septum connects the manifold to the pump vacuum line and permits syringe sampling.

This sampling system allows the sample to be taken upstream of the sampling pump, manifold, and septum. Since cross contamination of sampling equipment can be a major problem, Tracer Research replaces the materials (probe and syringe), between sampling points, that contact the soil gas before or during sampling.

-Sampling Probes

Steel probes are used only once each day. To eliminate the possibility of cross contamination, they are washed with high pressure soap and hot water spray, or steam-cleaned. Enough sampling probes are carried on each van to avoid the need to re-use any during the day.

-Glass Syringes

Glass syringes are used for only one sample a day and are washed and baked out at night. If they must be used twice, they are purged with carrier gas (nitrogen) and baked out between probe samplings.

-Sampling Efficiency

Soil gas pumping is monitored by a vacuum gauge to ensure that an adequate flow of gas from the soil is maintained. A reliable soil gas sample can be obtained if the sample vacuum gauge reading is at least 2 inches Hg less than the maximum measured vacuum of the vacuum pump.

Analytical Quality Assurance Samples

Quality assurance samples are performed at the minimum frequencies listed in Table 2. The actual frequency depends on the number of samples analyzed each day and the length of time of the survey.

Table 2. Quality Assurance Samples

Sample type	Frequency
Ambient Air Samples	2 per day or 1 per site
Analytical Method Blanks	5% (1 per 20 samples or 1 a day)
Continuing Calibration Check	20% (1 every 5 samples)
Field System Blank	2 per day
Reagent Blank	1 per set of working standards
Replicate Analyses	10 to 100% of all samples

The ambient air samples are obtained on site by sampling the air immediately outside the mobile analytical van and directly injecting it into the GC. Analytical method (nitrogen) blanks are taken to demonstrate that the analytical instrumentation is not contaminated. These are performed by injecting carrier gas (nitrogen) into the GC with the sampling syringe. Subsampling syringes are also checked in this fashion.

Continuing calibration checks are analyzed to verify the detector response for the target VOCs. If the response changes by more than 25 percent, the gas chromatograph is recalibrated and new response factors are calculated.

Field system blanks are analyzed to check for contamination of the sampling apparatus, e.g., probe and sampling syringe. For this investigation, a sample is collected by attaching the probe and manifold to a cylinder of Zero Air. If the field system blanks detect compounds of interest at concentrations that indicate equipment contamination or concentrations that exceed normal background levels (ambient air analysis), corrective actions are performed. If the problem cannot be corrected, an out-of-control event is documented and reported. For this investigation, field system blanks were performed at the beginning and end of each day.

A reagent blank is performed to ensure the solvent used to dilute the stock standards is not contaminated.

Quantitative precision is assured by replicating analysis of 10 to 100 percent of the samples. The percentage is based on the sample analysis time. Replicate analyses are performed by subsampling vapors from the same sampling syringe.

The injector port septa through which soil gas samples are injected into the GC are replaced daily to prevent possible gas leaks from the chromatographic column. All sampling and subsampling syringes are decontaminated after use and are not used again until they have been decontaminated by washing in anionic detergent and baking at 90°C.

6.0 RESULTS

The analytical results from this *Vapor Trace®* soil gas investigation are condensed in Appendix A. The data are presented by location and by analyte concentration. When the compound was not detected, the detection limit is presented as a "less than" value, e.g., <0.01 µg/L. The three point calibration data is included in Appendix B.

Soil gas samples are identified by sample location and sampling depth. For example, SG-02-3' represents a soil gas sample collected at location 2 in the designated area at a depth of 3 feet bgs.

The collocated and replicated samples are identified by "COL" and "REP", respectively, after the sample name. Elevated vinyl chloride detection limits due to C_1-C_3 hydrocarbons are designated with an "m" next to the detection limit.

APPENDIX A Condensed Data

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/16/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK I	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK II	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.003	<0.003	<0.002
AREA E26								
SG-02-3'	<0.06	<0.4	<0.1	<0.002	<0.1	<0.002	0.3	2
SG-03-3.5'	<0.2	<2	<0.6	<0.009	<0.5	<0.007	<0.1	4
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.01	<0.01
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002

Analyzed by: K. Ptak
Proofed by: K. McWilliams

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/17/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
AREA E26								
SG-05-6'	<0.1	<0.8	<0.3	0.004	<0.2	0.007	0.02	0.3
SG-07-5'	<0.1	<0.8	<0.3	<0.004	<0.2	0.003	<0.02	13
SG-14-4'	<0.1	<0.8	<0.3	<0.004	<0.2	<0.003	<0.02	<0.01
SG-15-3'	<0.1	<0.8	<0.3	<0.004	<0.2	<0.003	<0.02	0.01
SG-16-5.5'	<0.1	<0.8	<0.3	<0.004	<0.2	0.007	<0.02	0.04
SG-17-3'	<0.1	<0.8	<0.3	<0.004	<0.2	<0.003	<0.02	0.02
SG-17-3'REP	<0.06	<0.4	<0.1	<0.002	<0.1	<0.002	<0.008	0.03
SG-19-5'	<0.04	<0.3	<0.1	0.008	<0.08	0.1	12	4
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002

Analyzed by: K. Ptak
Proofed by: K. McWhirter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/18/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.001	<0.003	<0.002
AREA E26								
SG-09-6'	<0.06	<0.4	<0.1	0.002	<0.1	0.002	0.008	0.006
SG-10-5'	<0.06	<0.4	<0.1	<0.002	<0.1	0.06	<0.008	<0.006
SG-10-5'REP	<0.06	<0.4	<0.1	<0.002	<0.1	0.06	<0.008	<0.006
SG-32-4'	<0.06	<0.4	0.3	0.03	<0.1	0.005	34	6
AIR-26	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	0.001
SG-32-3'COL	<13	<84	<29	<0.4	<25	<0.3	91	8
SG-31-3'	<0.1	<0.8	<0.3	<0.004	<0.2	<0.003	<0.02	0.4
SG-30-3'	<0.06	<0.4	<0.1	<0.002	<0.1	<0.002	<0.008	0.01
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002

Analyzed by: K. Ptak
Proofed by: [illegible]

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/19/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
AREA E26								
SG-26-3'	<0.04	<0.3	<0.1	<0.001	<0.08	0.001	0.008	0.004
AREA E02								
SG-04-6'	<0.04	<0.3	<0.1	<0.001	<0.08	0.001	0.07	0.02
SG-04-6'REP	<0.04	<0.3	<0.1	<0.001	<0.08	0.001	0.07	0.02
SG-05-5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	0.05	0.02
SG-08-3.5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-09-3.5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-10-3.5'	<0.04	<0.3	<0.1	<0.001	<0.08	0.001	<0.006	<0.004
SG-11-4.5'	<0.04	<0.3	<0.1	0.001	<0.08	0.001	<0.006	<0.004
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002

Analyzed by: K. Ptak
Proofed by: R. McWilliams

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/20/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AREA E26								
SG-20-3'	<0.04	<0.3	<0.1	<0.001	<0.08	0.005	<0.006	0.05
AREA E02								
SG-17-6'	<0.04	<0.3	<0.1	<0.001	<0.08	0.004	<0.006	<0.004
SG-17-6'REP	<0.04	<0.3	<0.1	<0.001	<0.08	0.005	<0.006	<0.004
SG-21-4'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-19-4'	<0.04	<0.3	<0.1	<0.001	<0.08	0.006	<0.006	0.009
SG-22-3'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-03-3'	<0.04	<0.3	<0.1	0.001	<0.08	0.1	<0.006	0.01
AREA E03								
SG-03-4.5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-17-4.5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-17-5'COL	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002

Analyzed by: K. Ptak
Proofed by: [illegible signature]

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/21/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
AREA E03								
SG-18-6'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-07-6'	<0.04	<0.3	<0.1	<0.001	<0.08	0.002	<0.006	<0.004
SG-08-5.5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-09-5'	<0.04	<0.3	<0.1	<0.001	<0.08	0.009	<0.006	0.004
SG-10-5.5'	<0.04	<0.3	<0.1	<0.001	<0.08	0.001	<0.006	<0.004
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
SG-12-6'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	0.06
SG-13-6'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	0.004
SG-13-6'REP	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	0.004
SG-16-6'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-15-4.5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-21-5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
SG-20-3.5'	<0.04	<0.3	<0.1	<0.001	<0.08	0.003	<0.006	<0.004
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002

Analyzed by: K. Ptak
Proofed by: K. McWhirter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/23/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
AREA E01								
SG-13-3'	<0.04	<0.3	<0.1	<0.001	<0.08	0.02	<0.006	<0.004
SG-22-3'	<0.04	0.4	<0.1	<0.001	<0.08	0.002	0.006	<0.004
SG-16-3.5'	<0.04	<0.3	<0.1	<0.001	<0.08	0.006	<0.006	0.03
AREA E03								
SG-51-4.5'	<0.04	<0.3	<0.1	<0.001	<0.08	<0.001	<0.006	<0.004
AREA E02								
AIR	<0.02	<0.2	<0.06	<0.0009	<0.05	0.0007	<0.003	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.05	<0.0007	<0.003	<0.002

Analyzed by: K. Ptak
Proofed by: K. McWhorter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/29/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.06	0.0007	<0.004	<0.002
AREA S25F								
AIR	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002
SG-12-3'	<0.04	<0.3	<0.1	<0.002	<0.09	<0.001	0.006	0.004
AREA S25C								
SG-01-5.5'	<0.04	<0.3	<0.1	<0.002	<0.09	<0.001	<0.006	<0.004
SG-04-5'	<0.04	<0.3	<0.1	<0.002	<0.09	<0.001	<0.006	<0.004
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002

Analyzed by: K. Ptak
Proofed by: K. McWhirter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/30/93

SAMPLE	CH2Cl2 µg/L	1,1-DCA µg/L	TOTAL 1,2-DCE µg/L	CHCl3 µg/L	1,2 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
N2 BLANK	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.06	0.002	<0.004	0.004
AREA S25F								
SG-06-5'	<0.04	<0.3	<0.1	<0.002	<0.09	0.003	<0.006	0.004
SG-06-5'REP	<0.04	<0.3	<0.1	<0.002	<0.09	0.003	<0.006	0.004
SG-08-3'	<0.04	<0.3	<0.1	<0.002	<0.09	<0.001	<0.006	<0.004
SG-15-3'	<0.04	<0.3	<0.1	<0.002	<0.09	0.001	<0.006	0.004
AREA E26								
SG-01A-6'	<0.04	<0.3	<0.1	<0.002	<0.09	0.001	0.006	3
SG-02A-5.5'	<0.04	<0.3	<0.1	<0.002	<0.09	<0.001	0.006	0.1
SG-05A-3.5'	<0.04	<0.3	<0.1	0.01	<0.09	0.004	0.08	0.004
SYSTEM BLANK	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002
AIR	<0.02	<0.2	<0.06	<0.0009	<0.06	<0.0007	<0.004	<0.002

Analyzed by: K. Ptak
Proofed by: K. McWhinder

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/16/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK I	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK II	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E26						
SG-02-3'	<0.3	<0.4	<0.3	<0.7	<1	2*
SG-03-3.5'	<0.3	<0.4	<0.3	<0.7	<1	1*
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1

* TVHC concentration includes halocarbons

Analyzed by: K. Ptak
Proofed by: T. McWhirter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/17/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E26						
SG-05-6'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-07-5'	<0.3	<0.4	<0.3	<0.7	<1	6*
SG-14-4'	7	<140	150	140	310	4700
SG-15-3'	5	<1	2	2	5	31
SG-16-5.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-17-3'	<0.4	<0.6	<0.6	<1	<2	<2
SG-17-3'REP	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-19-5'	<0.3	<0.4	<0.3	<0.7	<1	6*
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1

* TVHC concentration includes halocarbons

Analyzed by: K. Ptak
Proofed by: K. McWhirter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/18/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E26						
SG-09-6'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-10-5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-10-5'REP	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-32-4'	<0.3	<0.4	<0.3	<0.7	<1	16*
AIR-26	<0.3	<0.4	<0.4	<0.7	<1	<1
SG-32-3'COL	<0.3	<0.4	<0.4	<0.7	<1	42*
SG-31-3'	<0.4	<0.6	<0.6	<1	<2	<2
SG-30-3'	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1

* TVHC concentrations included halocarbons

Analyzed by: K. Ptak
Proofed by: K. McWhirk

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/19/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E26						
SG-26-3'	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E02						
SG-04-6'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-04-6'REP	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-05-5'	<6m	<0.4	<0.3	<0.7	<1	<1
SG-08-3.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-09-3.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-10-3.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-11-4.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1

* TVHC concentration includes halocarbons

Analyzed by: K. Ptak
Proofed by: K. McMillen

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/20/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E26						
SG-20-3'	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E02						
SG-17-6'	<0.3	<0.4	0.4	<0.7	<1	8
SG-17-6'REP	<0.3	<0.4	0.3	<0.7	<1	8
SG-21-4'	<0.3	<0.4	<0.3	<0.7	<1	1
SG-19-4'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-22-3'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-03-3'	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E03						
SG-03-4.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-17-4.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-17-5'COL	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1

Analyzed by: K. Ptak
Proofed by: K McWilliams

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/21/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E03						
SG-18-6'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-07-6'	<0.6m	<0.4	<0.3	<0.7	<1	2
SG-08-5.5'	<5m	<0.4	<0.3	<0.7	<1	3
SG-09-5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-10-5.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-12-6'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-13-6'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-13-6'REP	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-16-6'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-15-4.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-21-5'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-20-3.5'	<0.5	<0.7	4	3	25	120
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1

* TVHC concentration includes halocarbons

Analyzed by: K. Ptak
Proofed by: K McWhirter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/23/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E01						
SG-13-3'	<0.3	<0.4	<0.3	<0.7	<1	<1
SG-22-3'	<1m	<11	3	<0.7	<1	100
SG-16-3.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E03						
SG-51-4.5'	<0.3	<0.4	<0.3	<0.7	<1	<1
AREA E02						
AIR	<0.3	<0.4	<0.3	<0.7	<1	<1
SYSTEM BLANK	<0.3	<0.4	<0.3	<0.7	<1	<1

* TVHC concentrations include halocarbons

Analyzed by: K. Ptak
Proofed by: K. McWilliams

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/29/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.2	<0.3	<0.3	<0.6	<1	<1
SYSTEM BLANK	<0.2	<0.3	<0.3	<0.6	<1	<1
AIR	<0.2	<0.3	<0.3	<0.6	<1	<1
AREA S25F						
AIR	<0.2	<0.3	<0.3	<0.6	<1	<1
SG-12-3'	<2m	<0.3	<0.3	<0.6	<1	14
AREA S25C						
SG-01-5.5'	<0.2	<0.3	<0.3	<0.6	<1	<1
SG-04-5'	<0.2	<0.3	<0.3	<0.6	<1	<1
SYSTEM BLANK	<0.2	<0.3	<0.3	<0.6	<1	<1

TVHC concentration includes halocarbons

Analyzed by: K. Ptak
Proofed by: K. McWhirter

TRACER RESEARCH CORPORATION-ANALYTICAL RESULTS
Harding Lawson Associates/Ft. Benjamin Harrison/Indianapolis, Indiana/Job No. 2-93-295-S
09/30/93

SAMPLE	VINYL CHLORIDE µg/L	BENZENE µg/L	TOLUENE µg/L	ETHLY BENZENE µg/L	XYLENES µg/L	TVHC C4-C12 µg/L
N2 BLANK	<0.2	<0.3	<0.3	<0.6	<1	<1
SYSTEM BLANK	<0.2	<0.3	<0.3	<0.6	<1	<1
AIR	<0.2	<0.3	<0.3	<0.6	<1	<1
AREA S25F						
SG-06-5'	<0.2	<0.3	<0.3	<0.6	<1	<1
SG-06-5'REP	<0.2	<0.3	<0.3	<0.6	<1	<1
SG-08-3'	<0.2	<0.3	<0.3	<0.6	<1	2
SG-15-3'	<0.2	<0.3	<0.3	<0.6	<1	<1
AREA E26						
SG-01A-6'	<0.2	<0.3	<0.3	<0.6	<1	2*
SG-02A-5.5'	<0.2	<0.3	<0.3	<0.6	<1	2
SG-05A-3.5'	<0.2	<0.3	<0.3	<0.6	<1	<1
SYSTEM BLANK	<0.2	<0.3	<0.3	<0.6	<1	<1
AIR	<0.2	<0.3	<0.3	<0.6	<1	<1

* THVC concentration includes halocarbons

Analyzed by: K. Ptak
Proofed by: K McWhirter

APPENDIX B Three Point Calibration Data

3-POINT CALIBRATION WORKSHEET | PG 1/4

Tracer Research Corporation | CLIENT- HARDING LAWSON

DATE- 09/16/93 ANALYST-K. PTAK | JOB NUMBER-2-93-295-S

C A L I B R A T I O N   D A T A

High-level Standard (ECD)	CH2CL2	1,1-DCA	t-1,2-DCE	CHCL3
STD INJECTION VOL-uL	5	5	5	5
INJ SYRINGE NUMBER	*****	*****	*****	*****
STD CONCENTRATION-ug/L	2000	4000	4000	100
STD RESPONSE 1-area	9081926	3711448	12578008	21870128
STD RESPONSE 2-area	9081926	3711448	12578008	21870128
REL % DIFFERENCE (RPD)	0.0%	0.0%	0.0%	0.0%
MEAN STD RESPONSE-area	9081926	3711448	12578008	21870128
RESPONSE FACTOR	1.10E-15	5.39E-15	1.59E-15	2.29E-17

Mid-level Standard (ECD)	CH2CL2	1,1-DCA	t-1,2-DCE	CHCL3
STD INJECTION VOL-uL	5	5	5	5
INJ SYRINGE NUMBER	*****	*****	*****	*****
STD CONCENTRATION-ug/L	200	400	400	10
STD RESPONSE 1-area	1200000	490952	1570598	2582768
STD RESPONSE 2-area	1200000	490952	1570598	2582768
REL % DIFFERENCE (RPD)	0.0%	0.0%	0.0%	0.0%
MEAN STD RESPONSE-area	1200000	490952	1570598	2582768
RESPONSE FACTOR	8.33E-16	4.07E-15	1.27E-15	1.94E-17

Low-level Standard (ECD)	CH2CL2	1,1-DCA	t-1,2-DCE	CHCL3
STD INJECTION VOL-uL	5	5	5	5
INJ SYRINGE NUMBER	*****	*****	*****	*****
STD CONCENTRATION-ug/L	20	40	40	1
STD RESPONSE 1-area	130000	53095	190349	299356
STD RESPONSE 2-area	130000	53095	190349	299356
REL % DIFFERENCE (RPD)	0.0%	0.0%	0.0%	0.0%
MEAN STD RESPONSE-area	130000	53095	190349	299356
RESPONSE FACTOR	7.69E-16	3.77E-15	1.05E-15	1.67E-17

Statistics (ECD)	CH2CL2	1,1-DCA	t-1,2-DCE	CHCL3
HIGH-LEVEL STD RF	1.10E-15	5.39E-15	1.59E-15	2.29E-17
MID-LEVEL STD RF	8.33E-16	4.07E-15	1.27E-15	1.94E-17
LOW-LEVEL STD RF	7.69E-16	3.77E-15	1.05E-15	1.67E-17
MEAN RESPONSE FACTOR	9.01E-16	4.41E-15	1.30E-15	1.96E-17
STANDARD DEVIATION	1.76E-16	8.62E-16	2.71E-16	3.09E-18
RELATIVE STD DEVIATION	19.5%	19.5%	20.8%	15.7%

Field Program Entries (ECD)	CH2CL2	1,1-DCA	t-1,2-DCE	CHCL3
INJECTION VOLUME	5	5	5	5
STANDARD CONCENTRATION	200	400	400	10
RESPONSE AREA	1109610	453539	1532889	2545659

3-POINT CALIBRATION WORKSHEET

Tracer Research Corporation CLIENT- HARDING LAWSON

DATE- 09/16/93 ANALYST- K. PTAK JOB NUMBER-2-93-295-S

CALIBRATION DATA

High-level Standard	ECD			
	1,2-DCA	TCA	TCE	PCE
STD INJECTION VOL-uL	5	5	5	5
INJ SYRINGE NUMBER	*****	*****	*****	*****
STD CONCENTRATION-ug/L	4000	50	100	50
STD RESPONSE 1-area	14372872	16874768	20725008	21674048
STD RESPONSE 2-area	14372872	16874768	20725008	21674048
REL % DIFFERENCE (RPD)	0.0%	0.0%	0.0%	0.0%
MEAN STD RESPONSE-area	14372872	16874768	20725008	21674048
RESPONSE FACTOR	1.39E-15	1.48E-17	2.41E-17	1.15E-17

Mid-level Standard	ECD			
	1,2-DCA	TCA	TCE	PCE
STD INJECTION VOL-uL	5	5	5	5
INJ SYRINGE NUMBER	*****	*****	*****	*****
STD CONCENTRATION-ug/L	400	5	10	5
STD RESPONSE 1-area	1937685	1562844	1845017	2404634
STD RESPONSE 2-area	1937685	1562844	1845017	2404634
REL % DIFFERENCE (RPD)	0.0%	0.0%	0.0%	0.0%
MEAN STD RESPONSE-area	1937685	1562844	1845017	2404634
RESPONSE FACTOR	1.03E-15	1.60E-17	2.71E-17	1.04E-17

Low-level Standard	ECD			
	1,2-DCA	TCA	TCE	PCE
STD INJECTION VOL-uL	5	5	5	5
INJ SYRINGE NUMBER	*****	*****	*****	*****
STD CONCENTRATION-ug/L	40	0.5	1	0.5
STD RESPONSE 1-area	210000	120000	150000	250000
STD RESPONSE 2-area	210000	120000	150000	250000
REL % DIFFERENCE (RPD)	0.0%	0.0%	0.0%	0.0%
MEAN STD RESPONSE-area	210000	120000	150000	250000
RESPONSE FACTOR	9.52E-16	2.08E-17	3.33E-17	1.00E-17

Statistics	ECD			
	1,2-DCA	TCA	TCE	PCE
HIGH-LEVEL STD RF	1.39E-15	1.48E-17	2.41E-17	1.15E-17
MID-LEVEL STD RF	1.03E-15	1.60E-17	2.71E-17	1.04E-17
LOW-LEVEL STD RF	9.52E-16	2.08E-17	3.33E-17	1.00E-17
MEAN RESPONSE FACTOR	1.13E-15	1.72E-17	2.82E-17	1.06E-17
STANDARD DEVIATION	2.34E-16	3.19E-18	4.70E-18	7.97E-19
RELATIVE STD DEVIATION	20.8%	18.5%	16.7%	7.5%

Field Program Entries	ECD			
	1,2-DCA	TCA	TCE	PCE

INJ IME	5			5
STAND CONCENTRATION	400	5		5
RESPONSE AREA	1777224	1452227	1773914	2348805
RF SHOULD BE	1.13E-15	1.72E-17	2.82E-17	1.06E-17

3-POINT CALIBRATION WORKSHEET — PG 3/4

Tracer Research Corporation — CLIENT- HARDING LAWSON

DATE- 09/16/93 ANALYST-K. PTAK — JOB NUMBER-2-93-295-S

C A L I B R A T I O N   D A T A

High-level Standard	FID			
	VINYL CHLORIDE	XXXXX	XXXXX	
STD INJECTION VOL-uL	200			
INJ SYRINGE NUMBER	3324			
STD CONCENTRATION-ug/L	24.4			
STD RESPONSE 1-area	313565			
STD RESPONSE 2-area	313565			
REL % DIFFERENCE (RPD)	0.0%	ERR	ERR	ERR
MEAN STD RESPONSE-area	313565	0	0	0
RESPONSE FACTOR	1.56E-14	ERR	ERR	ERR

Mid-level Standard	FID			
	VINYL CHLORIDE	XXXXX	XXXXX	
STD INJECTION VOL-uL	100			
INJ SYRINGE NUMBER	3324			
STD CONCENTRATION-ug/L	24.4			
STD RESPONSE 1-area	179755			
STD RESPONSE 2-area	179755			
REL % DIFFERENCE (RPD)	0.0%	ERR	ERR	ERR
MEAN STD RESPONSE-area	179755	0	0	0
RESPONSE FACTOR	1.36E-14	ERR	ERR	ERR

Low-level Standard	FID			
	VINYL CHLORIDE	XXXXX	XXXXX	
STD INJECTION VOL-uL	50			
INJ SYRINGE NUMBER	3324			
STD CONCENTRATION-ug/L	24.4			
STD RESPONSE 1-area	70099			
STD RESPONSE 2-area	70099			
REL % DIFFERENCE (RPD)	0.0%	ERR	ERR	ERR
MEAN STD RESPONSE-area	70099	0	0	0
RESPONSE FACTOR	1.74E-14	ERR	ERR	ERR

Statistics	FID			
	VINYL CHLORIDE	XXXXX	XXXXX	
HIGH-LEVEL STD RF	1.56E-14	ERR	ERR	ERR
MID-LEVEL STD RF	1.36E-14	ERR	ERR	ERR
LOW-LEVEL STD RF	1.74E-14	ERR	ERR	ERR
MEAN RESPONSE FACTOR	1.55E-14	ERR	ERR	ERR
STANDARD DEVIATION	1.92E-15	ERR	ERR	ERR
RELATIVE STD DEVIATION	12.3%	ERR	ERR	ERR

INJECTION VOLUME	100	0	0	0
STANDARD CONCENTRATION	24.4	0	0	0
RESPONSE AREA	157281	ERR	ERR	ERR
RF SHOULD BE	1.55E-14	ERR	ERR	ERR

3-POINT CALIBRATION WORKSHEET PG 4/4

Tracer Research Corporation CLIENT- HARDING LAWSON

DATE- 09/16/93 ANALYST- K. PTAK JOB NO- 2-93-295-S

C A L I B R A T I O N D A T A

High-level Standard (FID)	BEN	TOL	EBEN	o-XYL	TVHC
STD INJECTION VOL-uL	5	5	5	5	NA
INJ SYRINGE NUMBER	*****	*****	*****	*****	NA
STD CONC-ug/L	10000	10000	10000	10000	NA
STD RESPONSE 1-area	7401728	7037466	6025341	6383229	NA
STD RESPONSE 2-area	7401728	7037466	6025341	6383229	NA
REL % DIFF (RPD)	0.0%	0.0%	0.0%	0.0%	NA
MEAN STD RESP-area	7401728	7037466	6025341	6383229	NA
RESPONSE FACTOR	6.76E-15	7.10E-15	8.30E-15	7.83E-15	NA

Mid-level Standard (FID)	BEN	TOL	EBEN	o-XYL	TVHC
STD INJECTION VOL-uL	5	5	5	5	NA
INJ SYRINGE NUMBER	*****	*****	*****	*****	NA
STD CONC-ug/L	1000	1000	1000	1000	NA
STD RESPONSE 1-area	760234	802824	696282	785837	NA
STD RESPONSE 2-area	760234	802824	696282	785837	NA
REL % DIFF (RPD)	0.0%	0.0%	0.0%	0.0%	NA
MEAN STD RESP-area	760234	802824	696282	785837	NA
RESPONSE FACTOR	6.58E-15	6.23E-15	7.18E-15	6.36E-15	NA

Low-level Standard (FID)	BEN	TOL	EBEN	o-XYL	TVHC
STD INJECTION VOL-uL	5	5	5	5	NA
INJ SYRINGE NUMBER	*****	*****	*****	*****	NA
STD CONC-ug/L	100	100	100	100	NA
STD RESPONSE 1-area	104117	97665	82039	62000	NA
STD RESPONSE 2-area	104117	97665	82039	62000	NA
REL % DIFF (RPD)	0.0%	0.0%	0.0%	0.0%	NA
MEAN STD RESP-area	104117	97665	82039	62000	NA
RESPONSE FACTOR	4.80E-15	5.12E-15	6.09E-15	8.06E-15	NA

Statistics (FID)	BEN	TOL	EBEN	o-XYL	TVHC
HIGH-LEVEL STD RF	6.76E-15	7.10E-15	8.30E-15	7.83E-15	NA
MID-LEVEL STD RF	6.58E-15	6.23E-15	7.18E-15	6.36E-15	NA
LOW-LEVEL STD RF	4.80E-15	5.12E-15	6.09E-15	8.06E-15	NA
MEAN RESPONSE FACTOR	6.04E-15	6.15E-15	7.19E-15	7.42E-15	6.70E-15
STANDARD DEVIATION	1.08E-15	9.95E-16	1.10E-15	9.23E-16	NA

Field Program Entries

	FID				
	BEN	TOL	EBEN	o-XYL	TVHC
INJECTION VOLUME	5	5	5	5	5
STANDARD CONC	1000	1000	1000	1000	1000
RESPONSE AREA	827158	812903	695283	673849	746075
RF SHOULD BE	6.04E-15	6.15E-15	7.19E-15	7.42E-15	6.70E-15

Tracer Research Corporation

Tracer Research Corporation appreciates the opportunity of being of service to your organization. Because we are constantly striving to improve our service to you, we welcome any comments or suggestions you may have about how we can be more responsive to the needs of your organization. If you have any questions about the field work, analytical results, or this report, please give Marty Favero a call at (602) 888-9400.

Appendix B

PCB SCREENING OF SURFACE SOIL

INTRODUCTION

This appendix describes the procedures for and results of screening tests performed on surface soil samples to assess the presence of polychlorinated biphenyls (PCBs). This screening was conducted under contract to the U.S. Department of the Army (Army) under the Total Environmental Program Support (TEPS) Contract DAAA15-91-D-0013, Delivery Order 0004 (Task 4) for the U.S. Army Soldier Support Center (USASSC). The USASSC is at Fort Benjamin Harrison (FBH) in Lawrence Township, Marion County, Indiana. HLA conducted the screening as part of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of Solid Waste Management Units (SWMUs) and an Environmental Investigation (EI) of non-RCRA sites. The screening test included the use of the EnSys, Inc., PCB Rapid Immunoassay Screen (RIS℗®) soil test.

The purpose of the PCB soil screening tests was to provide rapid on-site testing of soil for the presence of PCBs. The objectives of the PCB screening tests were to (1) assess the presence and approximate concentrations of PCBs in surface soil at the investigation locations and (2) delineate locations for subsequent RFI and EI site investigations.

MATERIALS AND METHODS

The procedures for soil sample collection and PCB screening tests are described in this section.

Sample Site Selection

On the basis of the initial site visit conducted by the Army and HLA, and information provided in the Enhanced PA (Weston, 1992), three sites were selected for PCB screening tests. The three sites evaluated were: (1) the Former Drum Storage Area, near Buildings 45 and 46, Solid Waste Management Unit (SWMU) #FBH8; (2) Directorate of Installation Support (DIS) Engineering/Maintenance, Building 26 (EI Site 4), and (3) the Electrical Shop, Building 4 (EI Site 5). Information regarding the possible historic use or storage of PCBs at these sites is included in Sections 6 (SWMU #FBH8) and 6A (EI Sites 4 and 5), respectively, in the Technical Sampling Plan (TSP) (HLA, 1993).

Surface Soil Collection

HLA collected surface soil samples for PCB testing from SWMU #FBH8 and from EI Sites 4 and 5 at locations specified in the TSP. The respective sample locations were identified in the field using marking flags. All equipment used to collect surface soil samples was decontaminated before sampling in accordance with procedures presented in the Field Operations Plan (FOP) (HLA, 1993 Appendix A). Samples were collected using either a hand trowel or hand auger.

Eighteen surface soil samples were collected at SWMU #FBH8 on an approximate 100-foot grid from a depth of 0.0 to 0.5 feet below ground surface (bgs). Surface vegetation was removed from each sampling location approximately 100 grams of the newly exposed soil was placed in a 125 ml amber glass wide mouth jar for each sample collected. This procedure was implemented at each of the SWMU #FBH8 sample locations. Figure 4.9 of the Final Phase I RFI Report (HLA, 1995) illustrates the location of each SWMU #FBH8 sample location.

Twenty-eight EI Site 4 surface soil samples were collected at locations spaced at approximately 50-foot intervals around the perimeter and north of Building 26 as illustrated in Figure 4.10. The area immediately surrounding Building 26 is paved. An independent subcontractor removed four-inch diameter asphalt cores from sites selected for PCB screening before sampling. The subcontractor used a rotary coring device lubricated and cooled with COR-approved water. At each EI Site 4 sample collection location approximately 100 grams of the exposed soil was placed in a 125-ml amber glass wide-mouth jar. A hand auger was used at locations where the thickness of the asphalt made use of the hand trowel impractical.

Twenty-one surface soil samples were collected at EI Site 5 locations spaced at approximately 25- to 45-foot intervals from areas east and south of Building 4, as illustrated in Figure 4.15. On the basis of PCB screening results and a site inspection that indicated soil discoloration, four additional samples subsequently were collected in areas suspected of containing PCBs. Each of the EI Site 5 sampling

locations was covered with crushed rock. At each location, the rock was scraped away with a rake until soil was revealed, and approximately 100 grams of the exposed soil were placed in a 125 ml amber glass wide-mouth jar.

Approximately 100 grams of soil for use as field blank material were collected in an area adjacent to the HLA field trailer from a location HLA believed to be free of PCB contamination. A 10-gram aliquot of this soil was analyzed with each group of 20 investigation samples to assess the probability of false positive test results.

PCB Screening Procedure

Soil samples were screened for the presence of PCBs using the RIS$^{c®}$ soil test. This method has been accepted by the U.S. Environmental Protection Agency (EPA) as Draft Method 4020. A copy of the manufacture's instructions for performing and interpreting the PCB screening assay is provided as Attachment 1 to this Appendix. PCBs were manufactured under a variety of trade names, including Aroclor. Aroclors are mixtures of PCB congeners and the mixtures are identified by four digit numbers following the name Aroclor. The first two digits (10 or 12) indicate that the congeners contain the biphenyl ring structure, and the last two digits indicate the weight percent of chlorine in the mixture (Merck 1989). Aroclor 1248, for example, consists of a mixture of PCB congeners having an average weight percent of chlorine of 48. The term "PCB" is often used to denote Aroclors and individual PCB congeners in a general sense. The term is used as such in this report.

Concentrations of PCBs in soil at FBH were unknown, therefore HLA requested that the manufacturer configure the PCB soil screening kits to indicate whether the concentration of PCBs in soil samples were less than 5 milligrams per kilogram (mg/kg), between 5 and 50 mg/kg, or greater than 50 mg/kg measured as Aroclor 1248. The rationale for selecting this range was based on regulatory criteria for PCBs in soil, and was based on selecting a sufficiently broad concentration range that would encompass likely concentrations of PCBs present in the FBH surface soil samples tested. PCB concentrations in soil are

regulated under the Toxic Substances Control Act (TSCA). The maximum permissible limit of PCBs in soil in nonrestricted areas under TSCA is 10 mg/kg (Code of Federal Regulations 761.125 [c] [4] [v]). HLA selected Aroclor 1248 as a standard for the PCB assay kits, because the Aroclors potentially present at the respective FBH investigation locations are not known, and because the test kit has an intermediate sensitivity to Aroclor 1248. Also, in matrices containing mixture containing a mixture of Aroclors, the test kit manufacturer has observed that a PCB test configured for Aroclor 1248 closely approximates total Aroclor concentration.

The PCB screening test is also sensitive to other individual Aroclors. A summary of the sensitivity of the PCB soil screening test to other Aroclors, as configured for this investigation, is presented in Table B1. Because the sensitivity of the PCB screening test is different depending on the Aroclor mixture present in the sample, accurate quantitation of Aroclor mixtures other than the Aroclor used to calibrate the PCB screening test (Aroclor 1248) cannot be expected with this PCB screening test. For example, the concentrations of Aroclors 1254 or 1260, if present in a soil, would be overestimated (measured as Aroclor 1248) because the PCB screening test is more sensitive to these Aroclor mixtures than it is to Aroclor 1248. Similarly, the concentrations of Aroclors 1242, 1232, 1016, or 1221 would be underestimated (measured as Aroclor 1248) because the test is less sensitive to these Aroclor mixtures than it is to Aroclor 1248.

Quality Control For PCB Screening

HLA performed the PCB screening procedure in the HLA field trailer at FBH. The quality control (QC) for the PCB screening included the following:

Aroclor Standards

Duplicate calibration standards were analyzed as part of the method calibration procedure. Analysis of duplicate standards during each calibration helped to assess the precision of the method. New calibration standards were analyzed with each new test kit used; one test kit was sufficient to screen four

samples. A valid PCB screening analysis was indicated when the optical density ([OD] photometer display) difference of the duplicate standards was 0.20 or less.

Blanks

Method Blank - Blank extraction solvent was analyzed to evaluate reagent and equipment contamination. Method blanks were analyzed at a frequency of one method blank for every 20 investigation samples.

Field Blank - One soil sample was collected from an area with no known history of PCB contamination. The field blank was analyzed to assess possible chemical or physical interference. An individual 10-gram aliquot of this soil sample was analyzed with each group of 20 investigation samples.

Duplicate Samples

Duplicate soil samples were analyzed to assess method precision. A duplicate sample was analyzed with each group of 20 investigation soil samples.

Confirmatory Laboratory Analyses

Soil samples screened for PCBs were submitted to Environmental Science & Engineering, Inc., (ESE) laboratory for confirmatory PCB analyses using EPA Method 8080. Six soil samples were submitted for confirmatory analyses for evaluation of screening test results. Information provided by the manufacturer indicates that the PCB screening test has shown excellent correlation with laboratory analysis for split samples. The results of the PCB screening test show 80 to 95 percent correlation with laboratory confirmatory analyses. Non-correlating results are usually manifested as false positives on the part of the PCB screening test, rather than false negatives.

Matrix Spike Samples

Soil samples spiked with a known quantity of Aroclor 1248 were analyzed to assess performance of the method and the analyst. A minimum of one matrix spike (MS) sample was analyzed each day of PCB screening. The MS samples were prepared by adding a known volume of stock solution, prepared in advance by EnSys, Inc., to selected samples of FBH soil collected for the PCB screening.

RESULTS

This section provides a summary of the results of the PCB soil screening tests. Table B2 summarizes the PCB screening results for the samples collected from SWMU #FBH8 and Tables B3 and B4 summarize the PCB screening results for the samples collected from the respective EI Sites 4 and 5. Table B5 summarizes the results of the QC samples collected and analyzed as part of the PCB screening program. The results of the PCB screening tests are tabulated to indicate whether the concentration of PCBs is less than 5 mg/kg, between 5 and 50 mg/kg or greater than 50 mg/kg as Aroclor 1248. Because the PCB screening test was calibrated with an Aroclor 1248 mixture, the PCB screening data in the following subsections refer to concentrations as Aroclor 1248. PCB data from confirmatory analyses conducted by the ESE laboratory are reported as the specific Aroclor mixture identified by the laboratory.

RCRA Facility Investigation Site

The data presented in Table B2 indicate that the concentration of PCBs in the SWMU #FBH8 soil samples analyzed are less than 5 mg/kg, with the exception of the soil collected from the site identified as SM008PCB18. The sample from this location registered between 5 and 50 mg/kg PCBs. This soil sample was collected from a grass-covered depression on the eastern edge of a former drum storage area, which may serve as a natural drainage area and a collection area for contaminants for some portion of the surrounding area. The remaining portion of the sample was submitted to the ESE laboratory for confirmation analysis of PCBs. Results of the ESE laboratory's analysis (Table B2) indicated that soil collected from this location contained 2.20 mg/kg of Aroclor 1260. This result is in general agreement with the results obtained from the PCB screening test. As indicated in Table B1, the screening test is sensitive to 2.0 mg/kg of Aroclor 1260.

As indicated earlier in this report, PCB concentrations in the environment are regulated under the Toxic Substances Control Act (TSCA). The concentration of PCBs detected in samples collected from SWMU #FBH8 were less than the 10 mg/kg TSCA limit.

Environmental Investigation Sites

All soil samples collected from EI Site 4 tested negative for PCBs. The surface soil samples selected for PCB screening were collected from soil immediately below the paved parking lot of EI Site 4 or from surface soil on the periphery of the paved areas. Three soil samples collected from EI Site 4 were submitted to the ESE laboratory for confirmatory analysis of PCBs. Results of the laboratory analysis indicated that the PCB concentration in each of the samples was less than the concentration that could be detected by the PCB screening test (Table B3). The maximum concentration detected by the ESE laboratory analysis for the EI Site 4 samples was 0.076 mg/kg, which is less than the screening test's 2.0 mg/kg detector level for Aroclor 1260. The results of the ESE laboratory's analysis of the confirmatory samples were, therefore, in agreement with the results of the PCB screening test.

Soil samples collected from EI Site 5 tested negative for PCBs with the exception of samples collected from locations identified as EI005PCB10, EI005PCB12 and EI005PCB13 (Table B4). Soil collected from each of these locations were found to contain greater than 5 mg/kg, but less than 50 mg/kg Aroclor 1248. Subsequently, two of these samples (EI005PCB10 and EI005PCB13) were submitted to ESE for confirmatory PCB analyses. Results of the laboratory analysis indicated that EI005PCB10 contained 0.59 mg/kg of Aroclor 1260. The laboratory result for sample EI005PCB13 was less than the laboratory detection limit of 0.013 mg/kg. The observed discrepancy between the PCB screening test result and the laboratory result for sample EI005PCB13 may have resulted from sample heterogeneity or from variability of the screening test. As indicated earlier, the PCB screening test, usually manifests non-correlating results as false positives.

The presence of PCBs in the soil sample may be a result of the possible previous use or storage of PCB-containing equipment at this site. The concentrations of PCBs detected in samples collected from EI Site 5 all were well below the 10 mg/kg TSCA limit for PCBs.

Quality Control Data

Quality control samples were analyzed along with the investigative samples to assess the accuracy and precision of the PCB soil screening test. Table B5 provides a summary of the analytical results for method and field blanks, duplicates, and spiked samples. Results of the confirmatory analyses were discussed above.

Data from the analysis of the method and field blanks show that PCBs were not detected in any of the blanks analyzed. These data indicate that false positive readings resulting from reagent contamination or from matrix interferences were unlikely to occur.

Duplicate samples were analyzed to assess the precision of the PCB soil screening procedure. Agreement between the original sample and its replicate was generally very good with the exception of one sample. Sample EI005PCB09 was analyzed in duplicate; the original sample contained less than 5 mg/kg Aroclor 1248 (Table B4), while the duplicate sample contained greater than 50 mg/kg Aroclor 1248 (Table B5). Subsequently, the duplicate sample was reanalyzed (EI005PCB09 Dup Analyzed November 23, 1993) and found to contain less than 5 mg/kg Aroclor 1248, confirming the analytical results of the original analysis. The reason for the apparent false positive result (greater than 50 mg/kg Aroclor 1248) for the first duplicate sample may have been due to variability of the screening test. As indicated above, the PCB screening usually manifests non-correlating results as false positives.

Soil samples were spiked with different volumes of an Aroclor 1248 standard to assess the accuracy of the analysis. As shown in Table B5, the spiked concentration of Aroclor 1248 ranged from 7.5 to 60 mg/kg based on the volume of standard added. The PCB screening test successfully detected the presence of the added Aroclor in all spiked samples. Analysis of samples containing 7.5 mg/kg correctly tested as containing greater than 5 mg/kg , but less than 50 mg/kg PCB. The samples spiked with 15 mg/kg tested as greater than 5 mg/kg but less than 50 mg/kg in one sample and greater than 50 mg/kg in a second sample. Samples containing either 30 or 60 mg/kg PCB tested as containing greater than

50 mg/kg PCB. These results indicate that the PCB screening procedure, as conducted, tended to overestimate the concentration of PCBs present in the soil.

SUMMARY

Conclusions of the PCB soil screening performed on surface soil samples collected from three Fort Benjamin Harrison locations are as follows:

- The concentration of PCBs detected in the FBH surface soil samples using the PCB screening test and confirmed by laboratory analysis were less than the applicable TSCA limit of 10 mg/kg for PCBs in soil.
- PCBs were detected in one of 18 samples collected from SWMU #FBH8 at a concentration greater than 5, but less than 50 mg/kg (SM008PCB18). The presence of PCBs in the sample was confirmed (2.20 mg/kg) by subsequent laboratory analysis.
- PCBs were not detected at concentration above 5 mg/kg, measured as Aroclor 1248, in any of the 28 surface soil samples collected from EI Site 4. These results were corroborated by ESE laboratory analysis of three confirmation samples.
- PCBs were detected at concentrations that were greater than 5 mg/kg, but less than 50 mg/kg in three of 25 samples collected from EI Site 5 (EI005PCB10, EI005PCB12, EI005PCB13). The presence of PCBs was confirmed (0.590 mg/kg) in one of two samples submitted for laboratory analysis.
- Analysis of method and field blank samples indicated that false positive detections resulting from reagent contamination or matrix effects were unlikely.
- Analysis of duplicate samples indicated that the screening test is susceptible to some variability and that positive detections should be carefully evaluated before conclusions are drawn from the data.
- Analysis of QC soil samples spiked with Aroclor 1248 indicated that the screening test correctly identified all samples that contained the added PCBs.

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Merck and Company, Inc. 1989. *The Merck index, eleventh edition.* Merck and Company, Inc. Railway, NJ.

Roy F. Weston, Inc. 1992. *Delivery Order 9, enhanced preliminary assessment, Fort Benjamin Harrison, Indiana*: Prepared for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, February.

Table B1: PCB RIS©® Soil Test Detection Limits

Aroclor Congener	Detection Limit in Soil* (mg/kg)
Aroclor 1248	5
Aroclor 1254	2
Aroclor 1260	2
Aroclor 1242	10
Aroclor 1232	20
Aroclor 1016	20
Aroclor 1221	250

mg/kg Milligrams per kilogram
PCB Polychlorinated biphenyl
RIS©® EnSys, Inc., Rapid Immunoassay Screen

* Adapted from the ENSYS, Inc., Immunoassay Field Testing Kit Certification Course Manual 1992 - Field Testing Kit Detection Limits multiplied by the dilution factor of five.

Table B2: Summary of PCB Screening Results for Fort Benjamin Harrison Former Drum Storage Area, near Buildings 45 and 46 Solid Waste Management Unit #FBH8

Site Identification	Date Analyzed	5 mg/kg Analysis Interpretation	50 mg/kg Analysis Interpretation
SM008PCB01	11/22/93	<5	<50
SM008PCB02	11/22/93	<5	<50
SM008PCB03	11/22/93	<5	<50
SM008PCB04	11/22/93	<5	<50
SM008PCB05	11/22/93	<5	<50
SM008PCB06	11/22/93	<5	<50
SM008PCB07	11/22/93	<5	<50
SM008PCB08	11/22/93	<5	<50
SM008PCB09	11/22/93	<5	<50
SM008PCB10	11/22/93	<5	<50
SM008PCB11	11/23/93	<5	<50
SM008PCB12	11/23/93	<5	<50
SM008PCB13	11/23/93	<5	<50
SM008PCB14	11/23/93	<5	<50
SM008PCB15	11/23/93	<5	<50
SM008PCB16	11/23/93	<5	<50
SM008PCB17	11/23/93	<5	<50
SM008PCB18	11/23/93	>5*	<50

Confirmatory Sample Analysis Results

Site Identification	Concentration (mg/kg)	Aroclor Detected
SM008PCB18	2.20	Aroclor 1260

< Less than
> Greater than
mg/kg Milligrams per kilogram
PCB Polychlorinated biphenyls

* Value indicates a positive (detected) PCB screening test result for PCB.

Table B3: Summary of PCB Screening Results for Fort Benjamin Harrison DIS Engineering/Maintenance, Building 26 Environmental Investigation Site 4

Site Identification	Date Analyzed	5 mg/kg Analysis Interpretation	50 mg/kg Analysis Interpretation
EI Site 4			
EI004PCB01	11/20/93	<5	<50
EI004PCB02	11/20/93	<5	<50
EI004PCB03	11/20/93	<5	<50
EI004PCB04	11/20/93	<5	<50
EI004PCB05	11/20/93	<5	<50
EI004PCB06	11/21/93	<5	<50
EI004PCB07	11/21/93	<5	<50
EI004PCB08	11/21/93	<5	<50
EI004PCB09	11/21/93	<5	<50
EI004PCB10	11/21/93	<5	<50
EI004PCB11	11/21/93	<5	<50
EI004PCB12	11/21/93	<5	<50
EI004PCB13	11/20/93	<5	<50
EI004PCB14	11/20/93	<5	<50
EI004PCB15	11/22/93	<5	<50
EI004PCB16	11/22/93	<5	<50
EI004PCB17	11/20/93	<5	<50
EI004PCB18	11/22/93	<5	<50
EI004PCB19	11/20/93	<5	<50
EI004PCB20	11/22/93	<5	<50
EI004PCB21	11/20/93	<5	<50
EI004PCB22	11/20/93	<5	<50
EI004PCB23	11/20/93	<5	<50
EI004PCB24	11/22/93	<5	<50
EI004PCB25	11/22/93	<5	<50
EI004PCB26	11/22/93	<5	<50
EI004PCB27	11/22/93	<5	<50
EI004PCB28	11/22/93	<5	<50

Confirmatory Sample Analysis Results

Site Identification	Concentration (mg/kg)	Aroclor Detected
EI004PCB11	<0.013	---
EI004PCB14	<0.013	---
EI004PCB26	0.076	Aroclor 1260

Table B3 (continued)

<	Less than
>	Greater than
mg/kg	Milligrams per kilogram
PCB	Polychlorinated biphenyls

* Value indicates a positive (detected) PCB screening test result for PCB.

Table B4: Summary of PCB Screening Results for Fort Benjamin Harrison Electrical Shop, Building 4 Environmental Investigation Site 5

Site Identification	Date Analyzed	5 mg/kg Analysis Interpretation	50 mg/kg Analysis Interpretation
EI Site 5			
EI005PCB01	11/18/93	<5	<50
EI005PCB02	11/18/93	<5	<50
EI005PCB03	11/18/93	<5	<50
EI005PCB04	11/18/93	<5	<50
EI005PCB05	11/18/93	<5	<50
EI005PCB06	11/18/93	<5	<50
EI005PCB07	11/18/93	<5	<50
EI005PCB08	11/18/93	<5	<50
EI005PCB09	11/18/93	<5	<50
EI005PCB10	11/20/93	>5*	<50
EI005PCB11	11/20/93	<5	<50
EI005PCB12	11/20/93	>5*	<50
EI005PCB13	11/20/93	>5*	<50
EI005PCB14	11/20/93	<5	<50
EI005PCB15	11/20/93	<5	<50
EI005PCB16	11/20/93	<5	<50
EI005PCB17	11/20/93	<5	<50
EI005PCB18	11/20/93	<5	<50
EI005PCB19	11/20/93	<5	<50
EI005PCB20	11/20/93	<5	<50
EI005PCB21	11/20/93	<5	<50
EI005PCB22	11/23/93	<5	<50
EI005PCB23	11/23/93	<5	<50
EI005PCB24	11/23/93	<5	<50
EI005PCB25	11/23/93	<5	<50

Confirmatory Sample Analysis Results

Site Identification	Concentration (mg/kg)	Aroclor Detected
EI005PCB10	0.590	Aroclor 1260
EI005PCB13	<0.013	---

Table B4 (continued)

<	Less than
>	Greater than
mg/kg	Milligrams per kilogram
PCB	Polychlorinated biphenyls

* Value indicates a positive (detected) PCB screening test result for PCB.

Table B5: Summary of PCB Screening Results for Fort Benjamin Harrison-PCB Soil Screening Quality Control Samples

Site Identification	Class	Date Analyzed	5 mg/kg Analysis Interpretation	50 mg/kg Analysis Interpretation
Field Blank	FBLK	11/22/93	<5	<50
Field Blank	FBLK	11/23/93	<5	<50
Field Blank	FBLK	11/20/93	<5	<50
Method Blank	MBLK	11/18/93	<5	<50
Method Blank	MBLK	11/20/93	<5	<50
Method Blank	MBLK	11/22/93	<5	<50
Method Blank	MBLK	11/23/93	<5	<50
EI005PCB09	DUP	11/18/93	>5*	>50*
EI005PCB09	DUP	11/23/93	<5	<50
EI005PCB21	DUP	11/20/93	<5	<50
SM008PCB03	DUP	11/22/93	<5	<50
SM008PCB11	DUP	11/23/93	<5	<50
EI004PCB08	SPK (30 mg/kg)	11/21/93	>5*	>50*
EI004PCB15	SPK (30 mg/kg)	11/22/93	>5*	>50*
EI005PCB01	SPK (15 mg/kg)	11/18/93	>5*	<50
EI005PCB16	SPK (60 mg/kg)	11/20/93	>5*	>50*
SM008PCB04	SPK (15 mg/kg)	11/22/93	>5*	>50*
SM008PCB11	SPK (7.5 mg/kg)	11/23/93	>5*	<50

<	Less than
>	Greater than
DUP	Duplicate
FBLK	Field blank
MBLK	Method blank
mg/kg	Milligrams per kilogram
PCB	Polychlorinated biphenyls
SPK (Level)	Spike

* Value indicates a positive (detected) PCB screening test result for PCB.

Attachment 1

ENSYS PCB RIS$^{\underline{c}®}$ SOIL TEST SYSTEM ANALYSIS INSTRUCTIONS

Rev. 5 9/1/93

ENSYS INC.
ENVIRONMENTAL PRODUCTS

PCB RISc® SOIL TEST SYSTEM

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

WORKSTATION SET-UP

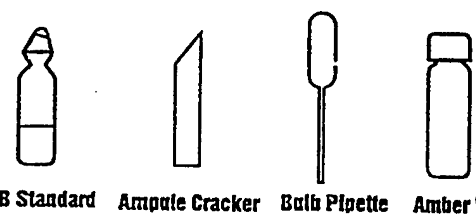
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Follow diagram below to setup workstation.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, disposable gloves.
- Do not expose reagents to direct sunlight.
- Do not attempt to run more that 12 tubes, two of which must be Standard tubes.
- Operate test at temperatures greater than 4°C / 40°F and less than 32°C /90°F.
- See table on page 9 for sensitivity to various aroclors.

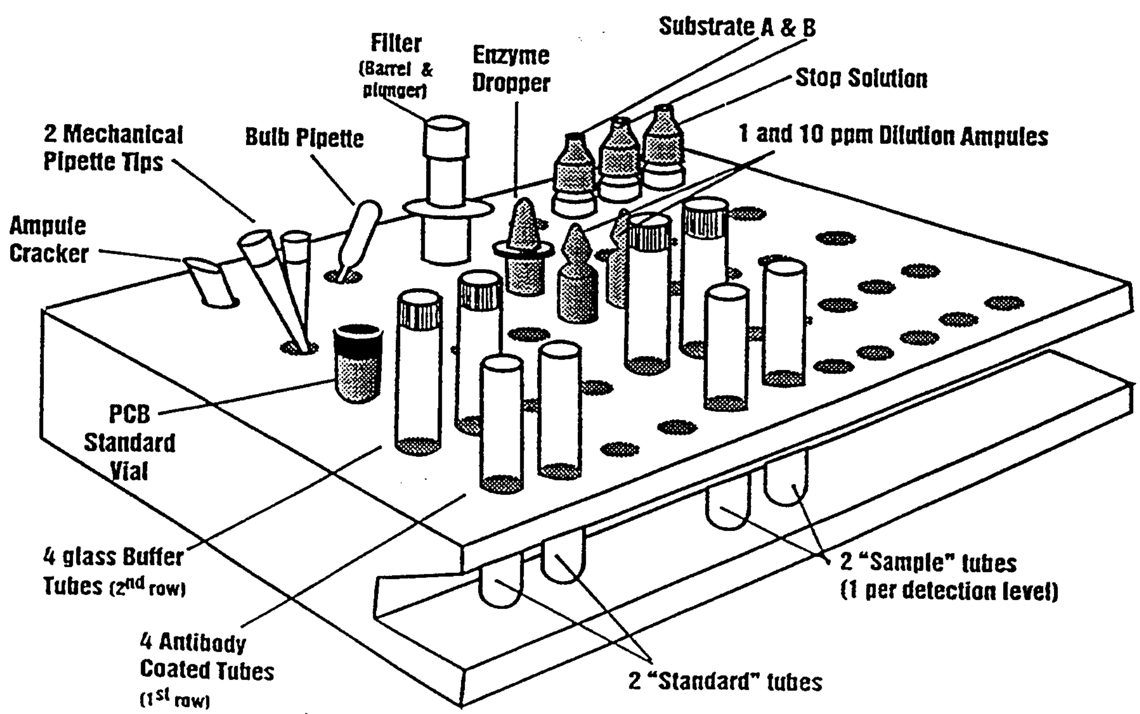
TEST PREPARATION

- Label amber vial "PCB Standard", and the current date, Standard is usable for up to 2 weeks from this date. Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer to empty amber vial with bulb pipette. Always cap tightly when finished using Standard.



WORKSTATION SET-UP (Workstation shows components for 1 sample tested at 2 levels)

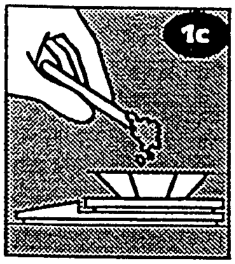
- ☐ Mechanical pipette tips
- ☐ Enzyme dropper
- ☐ PCB standard vial
- ☐ Substrate A
- ☐ Filtration barrel & plunger
- ☐ 1 and 10 ppm dilution ampules
- ☐ Substrate B
- ☐ Bulb pipette
- ☐ 4 glass buffer tubes
- ☐ Stop solution
- ☐ Ampule cracker
- ☐ 4 antibody coated tubes



PHASE 1 EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

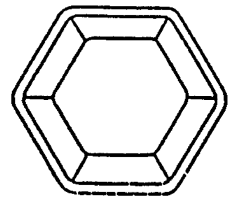


1a Place unused weigh boat on pan balance.

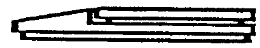
1b Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c Weigh out 10 ± 0.1 grams of soil.

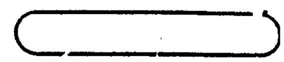
1d If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Weigh Boat

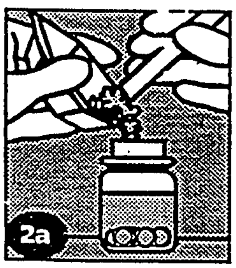


Pan balance



Wooden spatula

EXTRACT PCBS



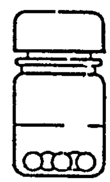
2a Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c Recap extraction jar tightly and shake vigorously for one minute.

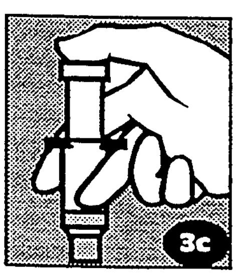
2d Allow to settle for one minute.

Repeat steps 1a - 2c for each sample to be tested.



Extraction Jar

FILTER SAMPLE

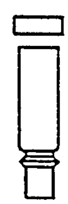


3a Disassemble filtration plunger from filtration barrel.

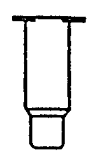
3b Insert bulb pipette into top (liquid) layer in extraction jar and draw up sample. Transfer at least ½ bulb capacity into filtration barrel. **Do not use more than one full bulb.**

3c Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps 3a - 3c for each sample to be tested.



Filtration plunger



Filtration barrel

Bulb pipette

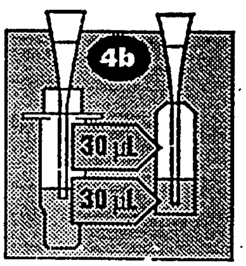
PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

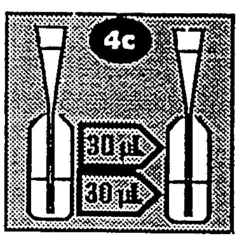
READ BEFORE PROCEEDING

- **Tap glass buffer tubes vigorously on hard surface to release buffer trapped in cap.**
- Label the glass buffer and plastic antibody coated tubes with a permament marking pen. Uncap glass buffer tubes.
- When using the mechanical pipette always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

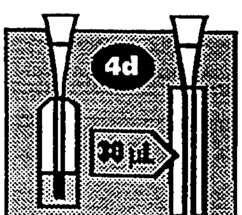
DILUTE SAMPLES AND STANDARDS

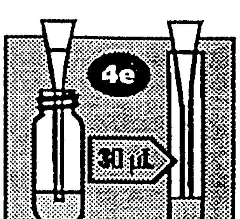


1 ppm



1 ppm 10 ppm





PCB Standard

4a Open 1 and 10 ppm* dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

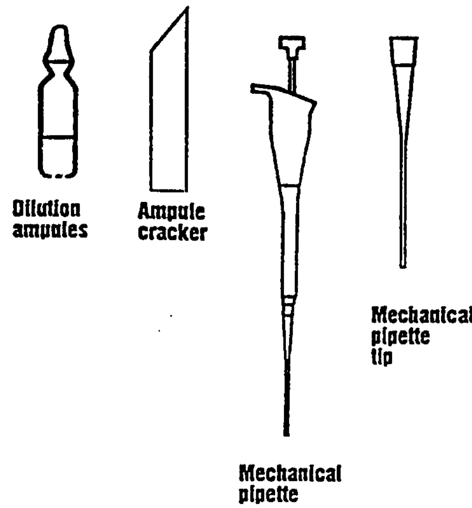
4b Withdraw 30 µL of filtered sample using mechanical pipette and dispense below the liquid level in "1 ppm" dilution ampule. Repeat to transfer a total of 60 µL; gently shake ampule from side to side for 5 seconds to mix thoroughly.

4c Withdraw 30 µL from the "1 ppm" dilution ampule using mechanical pipette and dispense below the liquid level in "10 ppm" dilution ampule. Repeat to transfer a total of 60 µL; gently shake ampule from side to side for 5 seconds to mix thoroughly.

4d Transfer 30 µL from each dilution ampule into a glass buffer tube. Always wipe tip after dispensing into buffer tube.

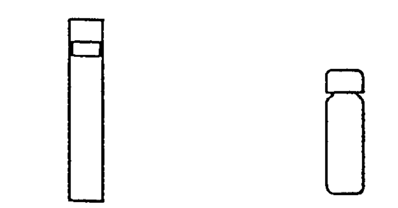
4e Assemble new pipette tip on mechanical pipette and transfer 30 µL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4f Shake all glass buffer tubes for 5 seconds.



*** For other test concentrations, follow steps 4b - 4d, transferring from lowest level dilution ampules to higher level dilution ampules. You may be provided with additional dilution ampules to achieve higher test concentrations.**

If you need assistance call technical support 1-800-242-7472



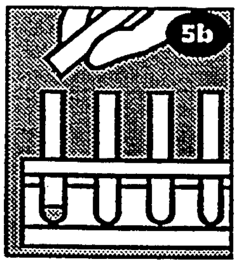
PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- This phase of the procedure requires critical timing and care in handling the antibody coated tubes.

INCUBATION 1



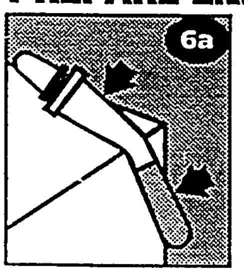
5a Set timer for exactly 10 minutes.

5b Start timing and immediately pour solution from each glass buffer tube into appropriate antibody coated tube. **Tap glass tube on antibody coated tube to remove solution.**

5c Shake all tubes for 5 seconds.

Antibody coated tubes (contained in resealable "zip-seal" aluminized pouch)

PREPARE ENZYME DROPPER

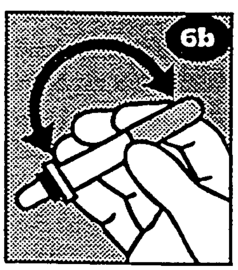


6a Crush glass ampule contained within enzyme dropper by pressing tube against hard edge.

6b Mix enzyme by turning dropper end-over-end 5 times. Do not shake.

6c Remove seal from enzyme dropper.

Repeat steps 6a - 6c to prepare one enzyme dropper for every 5 antibody coated tubes.

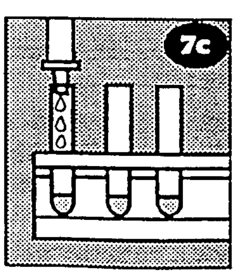


Enzyme dropper

INCUBATION II

7a Dispense first drop from enzyme dropper into liquid waste container.

Note: before dispensing drops, tap capped tip on hard surface to avoid dispensing air bubbles.



7b After the 10 minute incubation, set timer for 5 minutes.

7c Immediately dispense 3 drops of enzyme into each antibody coated tube by squeezing the dropper.

7d Shake antibody coated tubes for 5 seconds.

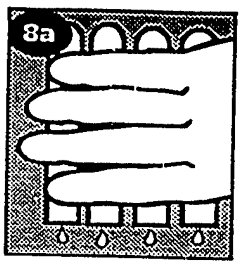
PHASE 3 THE IMMUNOASSAY

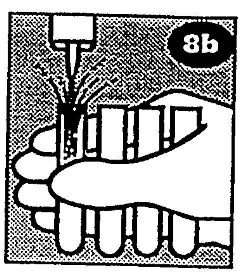
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING
WASH PROCEDURE

- An accurate test requires a virgorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH



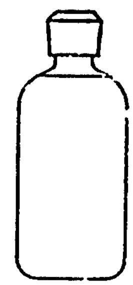


8a After the 5 minute incubation (a total of 15 minutes), empty antibody coated tubes into liquid waste container.

8b Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

8c Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.



Wash bottle

READ BEFORE PROCEEDING

- Keep Substrate dropper bottles vertical and direct each drop to bottom of antibody coated tubes. Addition of more or less than 5 drops may give inaccurate results.
- This phase requires accurate timing.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

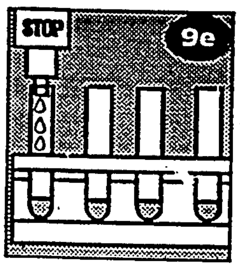
COLOR DEVELOPMENT

9a Add 5 drops of Substrate A (yellow cap) to each antibody coated tube.

9b Set timer for exactly 2 ½ minutes.

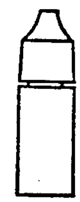
9c Start timer and immediately add 5 drops of Substrate B (green cap) to each antibody coated tube.

9d **Shake all tubes for 5 seconds.** Solution will turn blue in some or all antibody coated tubes.



9e Stop reaction at end of 2 ½ minutes by adding 5 drops of Stop Solution (red cap).

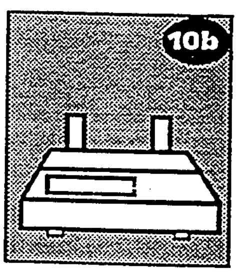
Note: Blue solution will turn yellow when Stop Solution is added.



Substrate bottles (A, B, & Stop Solution)

SELECT STANDARD

10a Wipe outside of all antibody coated tubes.



10b Place both Standard tubes in photometer.

10c Switch tubes until the photometer reading is negative or zero. Record reading.

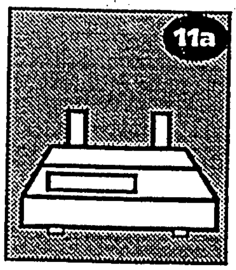
If reading is greater than 0.3 in magnitude (+ or -), results are outside QC limits. Retest the sample(s).

10d Remove and discard tube in right well. The tube in the left well is the darker standard.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

MEASURE SAMPLE



11a Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

11b Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.4 ppm
1260	0.4 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each PCB RISc Soil Test System contains enough material to perform four complete tests, each at two detection levels, if desired.

The PCB RISc Soil Test is divided into three phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-242-RISC (7472).

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the EnSys PCB RISc analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

The company does not guarantee that the results with the PCB RISc Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

EnSys, Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shall apply to this product.

EnSys, Inc. neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall EnSys, Inc. be liable for incidental or consequential damages resulting from the use or handling of this product.

How It Works

Standards, Samples, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown Sample is determined by comparing its color intensity with that of a Standard.

Note: PCB concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- **Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.**
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are **Standards**) at the same time.
- Do not exceed incubation periods prescribed by the specific steps.
- Always dispense correct number of drops and wash the number of times indicated in this guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

MECHANICAL PIPETTE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE MECHANICAL PIPETTE

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "030". Tighten volume lock screw and replace push-button cap.

To Assemble Pipette Tip

Slide larger mounting end of pipette tip onto end of pipette. Holding tip in place, press push-button until plunger rod enters pipette tip. Ensure no gap exists between piston and plunger rod (see illustration).

To Withdraw Sample

With tip mounted in position on pipette, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipette, please refer to your pipette manual.